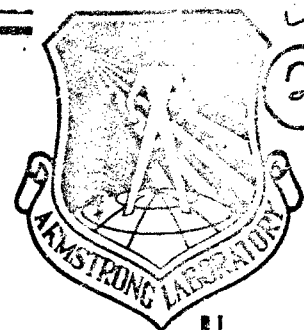


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**HORIZONTAL IMPACT TESTS OF THE  
ADVANCED DYNAMIC ANTHROPOMORPHIC  
MANIKIN (ADAM)**

Joseph P. Strzelecki  
John R. Buhrman

CREW SYSTEMS DIRECTORATE  
BIODYNAMICS AND BIOCOMMUNICATIONS DIVISION

JUNE 1990

FINAL REPORT FOR PERIOD NOVEMBER 1988 TO DECEMBER 1988

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FOR THE COMMANDER



JAMES W. BRINKLEY, SES  
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# PREFACE

The tests described within this report were accomplished by the Crew Protection Branch, Biodynamics and Bioengineering Division of the Armstrong Laboratory. The test and evaluation effort was accomplished at the request of the Crew Escape Technologies (CREST) Advanced Development Program Office (ADPO), Human Systems Division. Major Kenneth W. Nelms was the CREST program manager.

The impact facilities, data acquisition equipment, and data processing system were operated by the Scientific Services Division of DynCorp under Air Force contract F33615-86-C-0531. Mr Marshall Miller was the Engineering Supervisor for DynCorp.

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## LIST OF ABBREVIATIONS

ADAM	Advanced Dynamic Anthropomorphic Manikin
ADACS	Automatic Data Acquisition and Control System
CRIB	CREST Interface Board
DECOM	ADAM Decommutator Data Transmission System
DRASS	ADAM Data Retrieval and Storage System
NSD	No Significant Difference
RAM	ADAM On-Board Data Storage System
RCAL	ADAM Calibration Voltage
SRL	Systems Research Laboratories, Inc.

## INTRODUCTION

### Background

These tests were sponsored by the CREST ADPO to test and evaluate the production Advanced Dynamic Anthropomorphic Manikins (ADAMs) prior to their use in high cost ejection tests of CREST technologies at Holloman Air Force Base.

Two versions of ADAM were tested. Large ADAM approximates 97th percentile military flying personnel in height and weight. Small ADAM is approximately 3rd percentile. The ADAMs are designed to closely approximate the dynamic characteristics of the human body and are heavily instrumented to provide force, displacement, and acceleration data at key positions within the manikin.

To make the ADAM tests as realistic as possible, test fixtures were used which closely model the actual CREST seat. This was accomplished by the use of the correct seat back angle (-Gx tests), accurate representations of the seat back and seat pan, the actual CREST cushions, and the proposed harnesses.

The ADAMs were tested with two configurations of the CREST restraint harness. These are known as the X-Band 90° Hybrid (Figure 1) and the X-Band 45° Hybrid (Figure 2). The upper section is identical for both harnesses. The main difference between the 90° harness and the 45° harness is in the location of the attachments between the lower section of the harness and the seat. The 45° harness attaches to the seat with a pair of vertical straps and a second pair of attachments oriented at an angle of 45° with respect to the seat back tangent line. The 90° harness attaches to the seat with a pair of vertical straps and a second pair of attachments oriented at an angle of 82° with respect to the seat back tangent line.

### Objectives

The test program had four objectives:

- (1) To demonstrate the structural integrity of the ADAMs and their instrumentation systems.
- (2) To demonstrate the functional capability of the ADAM instrumentation system when undergoing impact.
- (3) To measure the dynamic response of the ADAMs by measurement of restraint load-time histories and body motion.
- (4) To demonstrate the stability of the production ADAM electronics with respect to the pre-test sensor sensitivities.

### Evaluation Criteria

The ADAMs were considered to have successfully met the test objectives if the following conditions were met:

ATTACHMENT STRAP FOR  
PARACHUTE RISER  
RELEASE FITTING

QUICK RELEASE ASSEMBLY

LEG STRAP  
ADJUSTERS

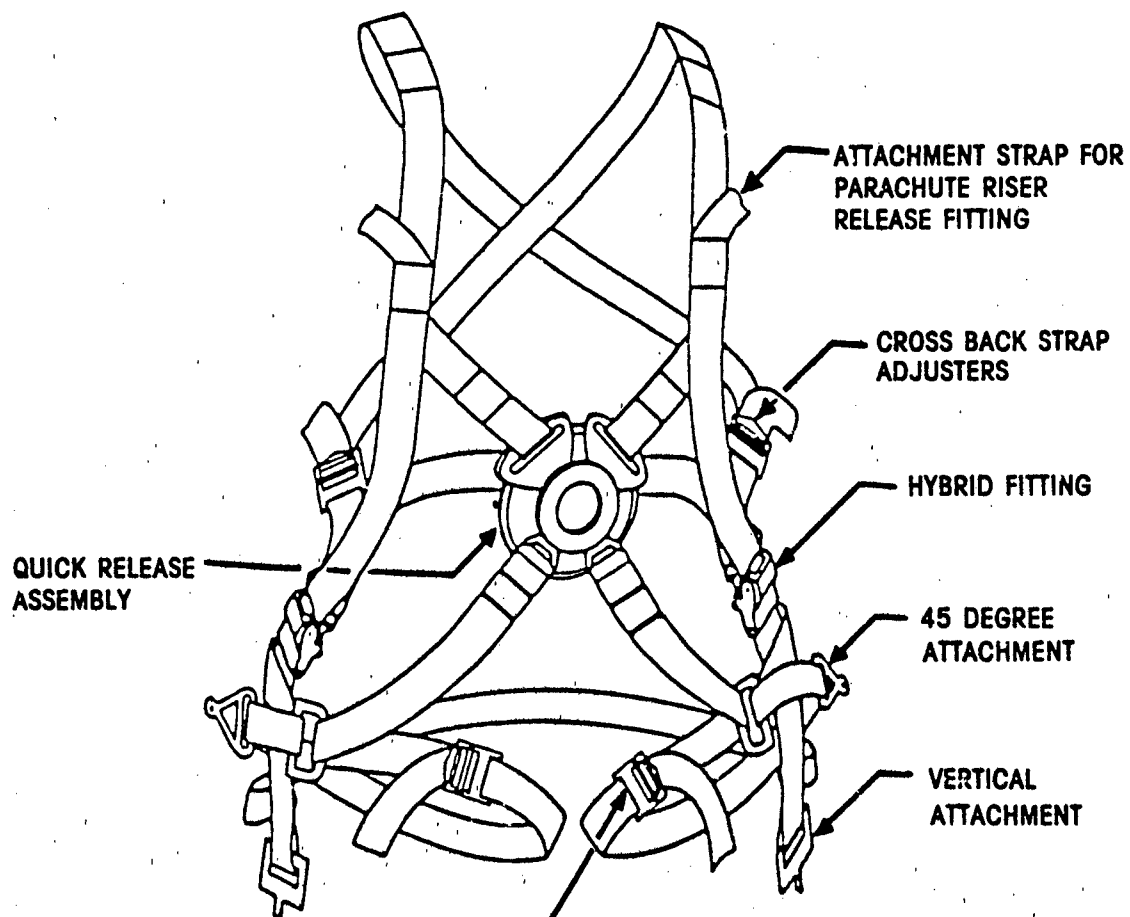
CROSS BACK  
STRAP ADJ.

HYBRID FITTING

HORIZONTAL ATTACHMENT

GZ ATTACHMENT LOOP

Figure 1: X-Band 90° Hybrid Harness



**Figure 2. X-Band 45° Hybrid Harness**

(1) The ADAMs showed no permanent deformation or failure of mechanical structures.

(2) There were no failures of any instrumentation associated with the nine channels designated critical.

(3) Critical channel data were present and continuous throughout each test.

(4) Critical channel data recorded from ADAM parallel sensor taps, RAM, and telemetry port agree within 5% in terms of amplitude and phase.

(5) ADAM dynamic response closely models human dynamic response.

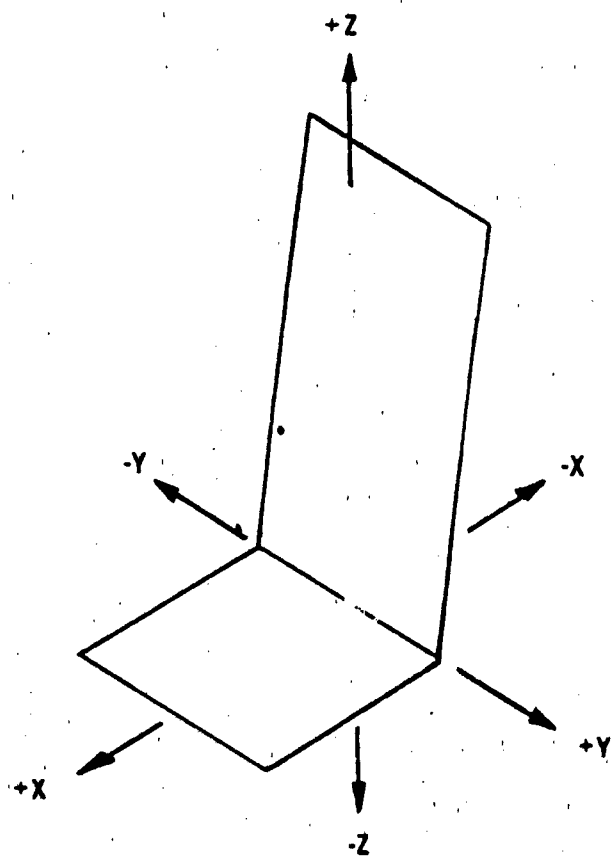
The nine critical channels for x-axis tests were:

1. Internal Temperature
2. Head Z Acceleration
3. Head X Acceleration
4. Chest X Acceleration
5. Head/Neck X Force
6. Head/Neck Z Force
7. Lumbar X Force
8. Lumbar X Acceleration
9. Neck Y-Axis Moment

The nine critical channels for y-axis tests were:

1. Internal Temperature
2. Head Z Acceleration
3. Head Y Acceleration
4. Chest Y Acceleration
5. Head/Neck Y Force
6. Head/Neck Z Force
7. Lumbar Y Force
8. Lumbar Y Acceleration
9. Neck X-axis Moment

Figure 3 shows the seat coordinate system.



**Figure 3: Acceleration Coordinate System**



## METHODS

### Facilities and Associated Procedures

The impact tests were performed using the Armstrong Laboratory (AL) Impulse Accelerator (Shaffer, 1976). The facility consists of a gas-operated actuator, a test sled, and track rails as shown in Figure 4.

Mounted to the sled was a generic seat, modified to represent the CREST ejection seat in an F-16 configuration. For the -Gx tests, the seat was placed on a 17° wedge to attain the correct 30° seat back angle (Figure 5). This wedge was not used for the +Gy tests to avoid large overturning moments. The seat back angle for the +Gy tests was 13° (Figure 6). The sled was ballasted to maintain a constant subject plus ballast weight of 220 lbs.

An outline of the test procedures follows: After Systems Research Laboratories Inc. (SRL) personnel had prepared the ADAM, it was brought to the test track. The ADAM was dressed in modified long underwear, boots, and for the +Gy tests, a flight helmet as well. The ADAM was placed in the seat and instrumentation "zeroes" were recorded. The ADAM was then strapped in and harness tensions were adjusted to try to achieve 20 ±5 lbs first in the horizontal anchors and then in the shoulder straps. This could not always be achieved, particularly with the small ADAM. No shoulder tension at all could be obtained for the small ADAM, so prior to -Gx testing an additional cushion was placed behind the small ADAM's back which allowed a small shoulder preload to be obtained (Figure 7).

Once preloads had been set, SRL personnel performed a pre-test check. Still photographs were taken of the test setup. The actual impact test was then carried out.

Primary measurements taken during the impact tests consisted of impact sled acceleration and velocity, loads measured at the attachment points of the restraint system, displacements of targets mounted on the ADAM, chest accelerations measured by an externally mounted accelerometer, and data from the nine critical channels listed earlier.

After each test photographs were again taken of the manikin. The ADAM was left undisturbed in the seat until it had downloaded all of its data.

Table 1 shows the sequence of tests performed for this program. Each ADAM was tested up to 14 G in the +y direction with both the X-Band 45° and X-Band 90° harnesses. The small ADAM was tested up to 45 G in the -x direction with both harnesses. The large ADAM was tested up to 45 G in the -x direction with the X-Band 90° harness but only to 30 G with the X-Band 45° harness. Testing was stopped at 30 G because it appeared likely that the 3400 lb design load for the 45° anchor strap would be greatly exceeded at higher G-levels.

Back-to-back tests at 20 G in the -x direction were run with each ADAM using the X-Band 45° harness. The same was done with the X-Band 90° harness at 30 G. The purpose of these tests was to check the repeatability of the ADAM data.

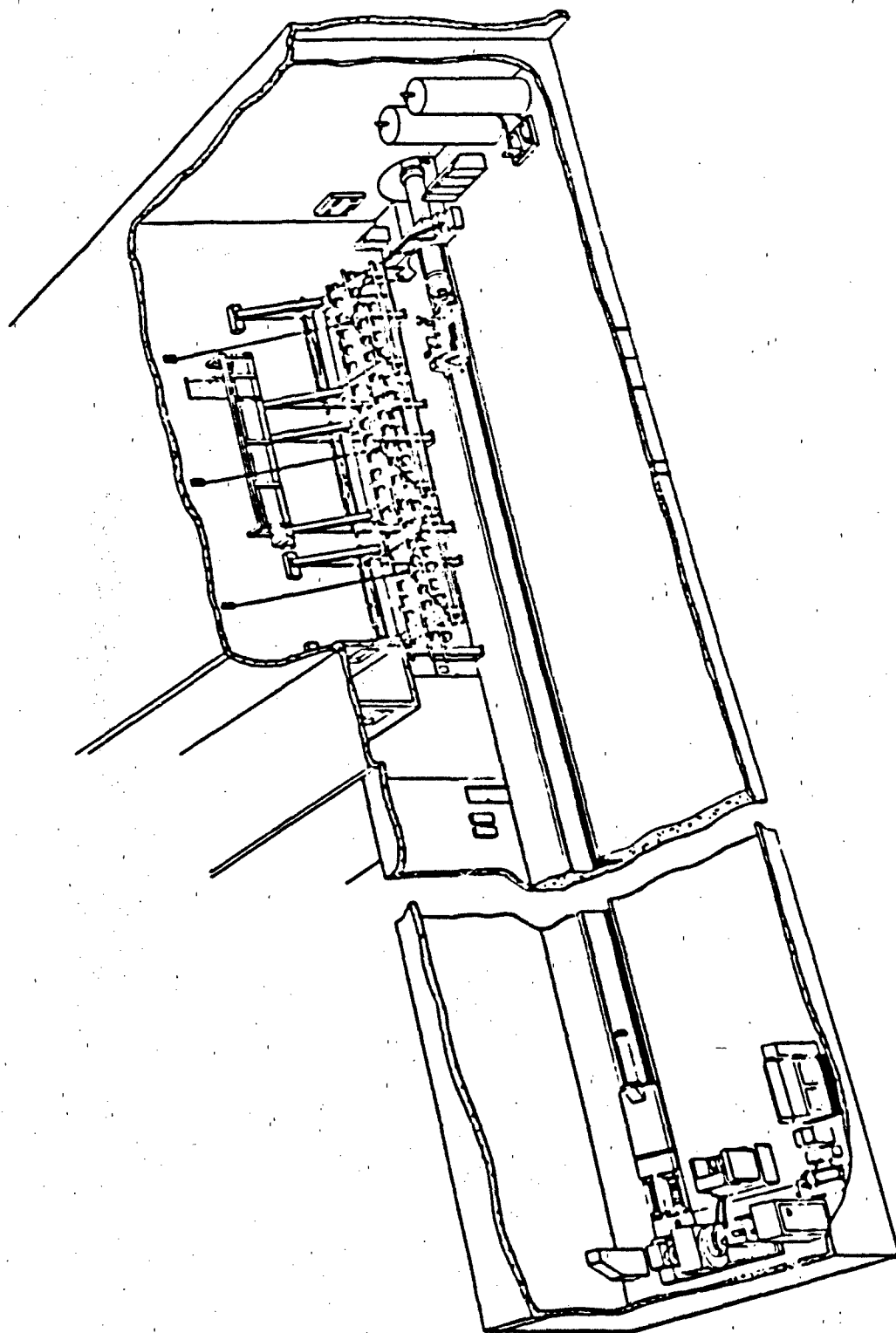


FIGURE 4. IMPULSE ACCELERATOR FACILITY

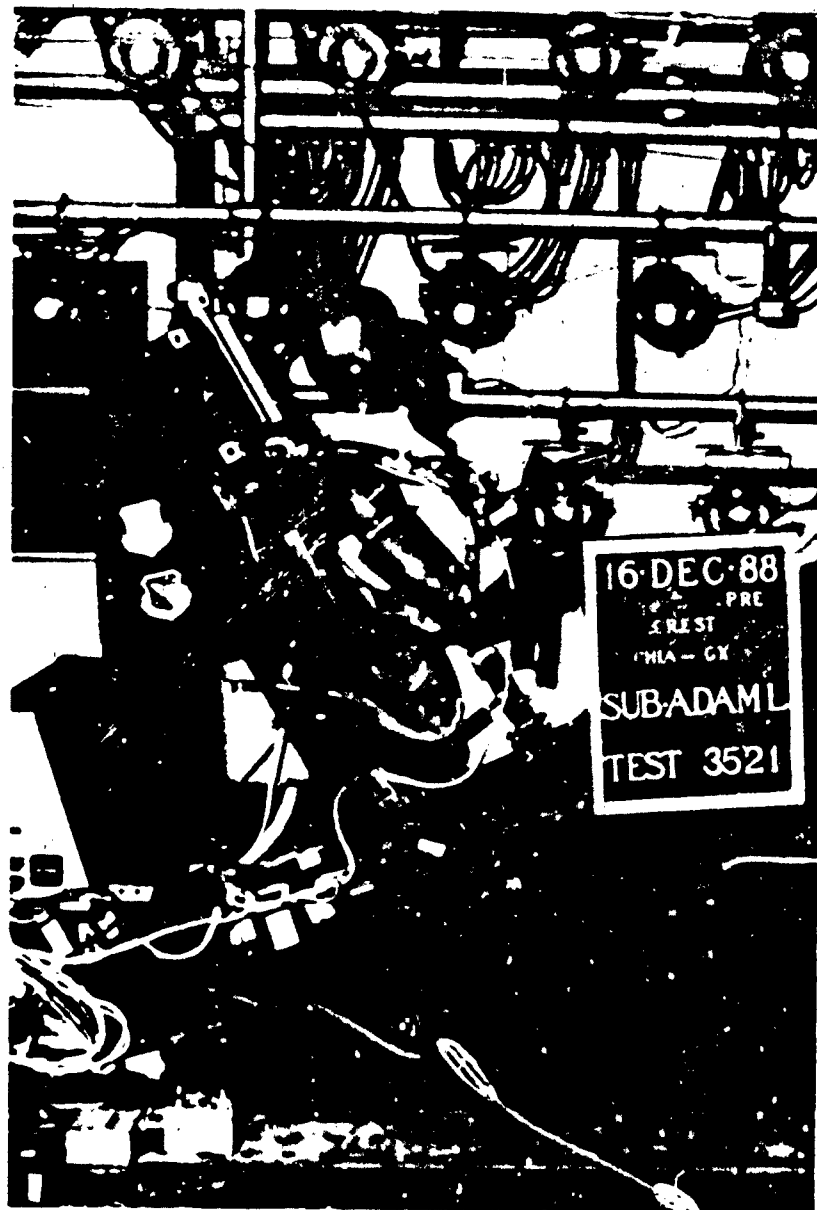


FIGURE 5: SLED SETUP FOR -G<sub>x</sub> TESTING



FIGURE 6: SLED SETUP FOR Gy TESTING



FIGURE 7: SMALL ADAM WITH EXTRA BACK CUSHION

The -10 Gx tests were intended to provide data for comparison with earlier human tests run at 10 G. This would allow evaluation of the ability of the ADAMS to simulate human response.

TABLE 1. TEST SEQUENCE

TEST	CELL	ACCEL	HARNESS	ADAM	POST CAL	NOTES
3484	A	+8Gy	X-45	S	YES	ADAM Failure
3485	A	+8Gy	X-45	L	YES	OK
3486	B	+11Gy	X-45	L	NO	OK
3487	C	+14Gy	X-45	L	YES	OK
3488	D	+6Gy	X-90	L	NO	No-Test
3489	E	+11Gy	X-90	L	NO	OK
3490	F	+14Gy	X-90	L	YES	OK
3491	D	+8Gy	X-90	S	NO	OK
3492	E	+11Gy	X-90	S	NO	OK
3493	F	+14Gy	X-90	S	YES	OK
3494	B	+11Gy	X-45	S	NO	ADAM Failure
3495	B	+11Gy	X-45	S	NO	OK
3496	C	+14Gy	X-45	S	YES	OK
3497*	D	+8Gy	X-90	L	YES	OK
3498	G	-10Gx	X-90	L	NO	OK
3499	H	-20Gx	X-90	L	YES	ADAM Failure
3500	G	-10Gx	X-90	S	NO	No-Test
3501*	G	-10Gx	X-90	S	NO	OK
3502	L	-10Gx	X-45	S	YES	No-Test
3503	L	-10Gx	X-45	L	YES	OK
3504r	M	-20Gx	X-45	L	NO	OK
3505r	M	-20Gx	X-45	L	YES	ADAM Failure
3506r	M	-20Gx	X-45	S	NO	OK
3507r	M	-20Gx	X-45	S	YES	OK
3511	N	-30Gx	X-45	S	YES	OK
3512	N	-30Gx	X-45	L	YES	OK
3513	O	-40Gx	X-45	S	YES	OK
3514	P	-45Gx	X-45	S	NO	No-Test
3515	H	-20Gx	X-90	S	YES	OK
3516	H	-20Gx	X-90	S	NO	No-Test
3517r	I	-30Gx	X-90	L	YES	OK
3518r	I	-30Gx	X-90	L	YES	ADAM Failure
3519r	I	-30Gx	X-90	S	YES	OK
3520r	I	-30Gx	X-90	S	YES	OK
3521	J	-40Gx	X-90	L	YES	No-Test/ADAM Failure
3523	J	-40Gx	X-90	S	YES	No-Test/ADAM Failure
3524*	J	-40Gx	X-90	S	YES	OK
3525*	J	-40Gx	X-90	L	YES	ADAM Failure
3526	K	-45Gx	X-90	S	NO	ADAM Failure
3527	K	-45Gx	X-90	L	NO	OK

Tests 3508, 3509, 3510, 3522, and 3528 were camera proof tests

\* Repeat of No-Test  
r Repeatability Test  
Failures 9/40

## ADAM and Associated Equipment and Procedures

Each of the ADAMs contained the following sensors: tri-axial linear accelerometers mounted in the head and chest, six-component load cells mounted in the head/neck and pelvis, position sensors mounted in the torso and limbs, and an externally mounted tri-axial chest accelerometer. A temperature sensor was mounted on the hottest board inside ADAM, the Analog-to-Digital Conversion board (ADC). Signal amplification, filtering, digitization, and temporary storage of data were provided by the internal ADAM electronic instrumentation system. Power for the ADAM internal electronics and sensor excitation was provided by the ADAM Field Power Supply (FPS).

ADAM pre and post electrical checks were performed for each test by injecting voltages into the input of each channel's amplification system. The output voltage of the channel was displayed in hex units on a hand-held display terminal and referred to as the RCal value along with the resting output condition which was referred to as the NonRCal value. Significant variations in either the expected RCal or NonRCal values were indicative of defective channels. In addition, a program was run which automatically printed out the RCal and NonRCal values just before and after impact, along with the differences in hex of the pre-impact RCal-NonRCal values and the post-impact RCal-NonRCal values. Differences between these two sets of values indicated drift in channel sensitivity. Channels were to be recalibrated if this difference exceeded 6 bits or 0.04 volts.

### Electronic Data Acquisition (ADACS, RAM and DECOM)

ADAM response data were collected over a period of four seconds by the ADAM data acquisition system and stored in the ADAM on-board memory (RAM). The ADAM data were also transmitted over its own line in a 250 foot whip cable via a decommutator (DECOM) and stored in the ADAM DRASS (Data Retrieval and Storage System). Following an ADAM test the data were downloaded from the DRASS to a Z-100 computer for temporary storage and then transferred to the VAX. The on-board RAM data were also downloaded into the DRASS, downloaded to the Z-100, and then transferred to the VAX. VAX software routines converted the data from binary format into engineering units and provided "quick look" plots of both RAM and DECOM channels.

Data were also collected via a non-ADAM system, the Automatic Data Acquisition and Control System (ADACS). Lines tapped at the ADAM transducers provided input to the ADACS. Signal filtering, amplification, and digitization took place on-board the sled. The ADACS data were transmitted to the computer room via the 250 foot whip cable and transferred to the VAX for comparison with the ADAM RAM and DECOM data. A list of the ADAM channel sensitivities was entered into the plotting routines in order to compensate for the different gains of the ADACS and the ADAM systems.

### Photogrammetric System

Two 16mm motion picture cameras, operated at 500 frames/sec, were mounted on the sled to record the movement of the test manikin and to document any failures which might occur. For the +Gy tests, one camera provided a frontal view of the seated manikin and the other camera provided a front oblique view. For the -Gx tests, one camera provided a front oblique view

of the manikin and the other camera provided a side view. Each camera was synchronized with the electronic data by a pulse code and an electronic flash.

A video camera was also used to document the tests. This camera and the recorder used with it are capable of recording motion at a rate of 120 frames/sec with an effective shutter speed of 10 microseconds or less. Use of this system allowed the investigators to evaluate the response to impact immediately after each test. This system is described in Appendix A.

#### Data Processing

Data from each test were reduced in a standardized format. Reduced electronic data are available for review within Appendix B. Computer summaries provide relevant maxima and minima from the recorded ADACS signals. Relevant sums and times were also computed. The sums of the measured force are the maximum values of continuously summed measurements. Scaled plots of selected signals from ADACS, RAM, and DECOM were produced.



## RESULTS

### Test-by-Test Narrative (+Gy)

#### 1. TEST 3484 Cell: A Subject: ADAM-S Result: ADAM Failure

**ELECTRICAL:** Noise was present in the Neck-Z Force channel prior to the test. Data initially could not be transferred from the ADAM to the DRASS due to a failure of the memory board in ADAM. ADAM did not receive the start signal, resulting in the loss of RAM data. The problem was attributed to a nicked wire which was shorting to the shielding. A large positive spike was present in the Z-Lumbar Force data (DECOM only) and a large negative spike was present in the Z-Lumbar Acceleration data. Excessive noise was present in the data on several channels (DECOM only). To prevent this problem from recurring in future tests, .01 uf capacitive filters were temporarily installed in the noisy small ADAM channel lines. The ADAM internal temperature data read 12° C lower than the ADACS temperature.

**STRUCTURAL:** Delamination of some zippers in the torso, arms, and legs was noticed before the test and delamination of a zipper in the pelvic area was observed after the test. A wire bundle in the right upper arm rotated. It was re-secured with tie-wraps after the test. Tears in the square corners of the skin in the armpit area and a puncture in the left upper wrist skin were noticed after the test. Two tears in the battery cover area of the skin in the back of ADAM were also noticed after the test.

**PROCEDURAL:** A change in the test plan called for the wrists to be placed left over right instead of tied together. The harness pre-tensions at the shoulders were lower than the 20 ± 5 lbs specified in the test plan, but were the maximum values which could be obtained.

#### 2. TEST 3485 Cell: A Subject: ADAM-L Result: ADAM Success

**ELECTRICAL:** The Left Lower Leg Torque Positive data was defective due to a broken wire in the left knee load cell, and the Left Lower Leg Torque Negative data showed excessive noise. Large negative spikes were present in the data on four DECOM channels and one RAM channel. The ADAM internal temperature read 29.5° C lower than the ADACS temperature in this test and averaged about 28° lower in the remaining +Gy tests. This difference was decreased to about 8° in the +Gx tests by measuring the temperature voltage offset between the ADAM and the ADACS systems, and changing the offset value in the processing program.

**STRUCTURAL:** The skin and zipper in the area of the right armpit showed slight damage prior to the test. This was due to rubbing of the clevis against this area. Also, a zipper at the top of the torso was bent by the harness strap during the test.

The damaged soft-stop in the left upper arm medial/lateral joint was replaced prior to the test and the soft-stop in the shoulder (abduction/adduction in the coronal plane) joint was reglued after the test. A tie-wrap in the right upper arm was repaired after the test.

3. TEST 3486 Cell: B Subject: ADAM-L Result: ADAM Success

ELECTRICAL: Large negative spikes were present in the Y-Lumbar Force data (DECOM only).

STRUCTURAL: The zipper pull at the top of the torso was again bent by the harness during the test. The upper arm medial/lateral soft-stop was damaged after the test and was reglued. Extra tie-wrap was added to the upper arm wire bundle after the test. The right shoulder cover came off during this test and also during large ADAM tests 3487, 3489, and 3490.

4. TEST 3487 Cell: C Subject: ADAM-L Result: ADAM Success

ELECTRICAL: Excessive noise was present in the Z-Chest Acceleration data. Large negative spikes were present in the data on one RAM channel and 6 DECOM channels.

STRUCTURAL: A slight abrasion in the neck assembly was observed after the test. This appeared to be caused by harness pressure on the zipper. A cut in the right shoulder skin was noticed after the test and was repaired. Also, a small puncture and tears in the right upper arm skin were observed. Soft-stops in the wrist and elbow were reglued after the test.

5. TEST 3488 Cell: D Subject: ADAM-L Result: No-Test

ELECTRICAL: The pre-test electrical check indicated a defective Z-Head Acceleration channel, caused by a broken wire which had been pinched during reassembly. The wire was replaced and insulated before testing. Large negative spikes were present in the data on three channels (DECOM only). The ADACS Lumbar Y Force data showed an offset of about -64 lbs.

STRUCTURAL: The right side center edge of the zipper towards the top of the torso was taped prior to the test and was torn slightly from the skin during the test. Damage to the wire-wraps around the right and left forearm stops was discovered after the test.

PROCEDURAL: Some difficulty occurred in attempting to obtain the proper harness pre-tensions due to the straps having a tendency to slip into the openings between the thigh and hip. During processing of the data after the +Gy testing had been completed, it was noticed that the ADACS file had been accidentally deleted by DynCorp, making this a "No-Test". This test was later rerun as Test 3497.

6. TEST 3489 Cell: E Subject: ADAM-L Result: ADAM Success

ELECTRICAL: Excessive noise was present in the X, Y, and Z-Chest Acceleration data. Large negative spikes were present in the Y-Neck Moment data (RAM only).

STRUCTURAL: The zipper assembly in the right shoulder was torn during the test and had to be replaced. A small puncture in the left upper arm skin which was incurred in previous tests was repaired prior to the test. Damage was noticed after the test on the inside of the skin due to contact with the neck block. Three shoulder soft-stops became slightly unglued and were repaired after the test. Slight binding in the upper arm medial/lateral wiring was noticed after the test.

7. TEST 3490 Cell: F Subject: ADAM-L Result: ADAM Success

ELECTRICAL: A broken wire from the left hip to the telemetry port in the head was noticed after the test. However, the data in the left hip channels appeared to have been unaffected. Large negative spikes were present in the data on one RAM channel and 7 DECOM channels.

STRUCTURAL: A puncture in the inside skin on the right side of the torso was noticed after the test, caused by contact with the neck block.

8. TEST 3491 Cell: D Subject: ADAM-S Result: ADAM Success

ELECTRICAL: The Right Arm Coronal Abductor data was faulty due to a cold solder joint in the associated pot wiper. Excessive noise was present in the X-Lumbar Acceleration and Left Lower Leg Torque Negative data. Large negative spikes were present in the data on three channels (DECOM only) The ADACS internal temperature increased 15° C from the previous small ADAM test, while the ADAM temperature increased by only 1° C.

STRUCTURAL: Two tie-wraps in the left elbow were replaced after the test when a loose fit was noticed.

PROCEDURAL: The harness straps for both the hips and shoulders were unable to be adjusted to the required pre-tensions due to the small size of ADAM.

9. TEST 3492 Cell: E Subject: ADAM-S Result: ADAM Success

ELECTRICAL: Excessive noise was present in the Left Lower Leg Torque Negative data. A Large negative spike was present in the data on one RAM and one DECOM channel.

10. TEST 3493 Cell: F Subject: ADAM-S Result: ADAM Success

ELECTRICAL: Excessive noise was present in the the X-Lumbar Acceleration, Right Sternoclavicular Elevation/Depression,

and Left Lower Leg Torque Negative data. A dropout occurred in the Right Hip Flexion data due to an intermittent open. The post-test electrical check showed four channels in need of recalibration. This was to be accomplished prior to the next test. Line 3 of the A/D multiplexor was damaged and later replaced. This may have been causing the noise in Test 3484.

11. TEST 3494    Cell: B    Subject: ADAM-S    Result: ADAM Failure

ELECTRICAL: Both the RAM and DECOM data were lost due to a failure of the ADAM to DRASS data transfer. The problem was caused by a defective power supply in the digital I/O board. The defective board was replaced and the RAM data was retrieved, but none of the channels showed any response. The malfunction could therefore have occurred either before or during the test.

STRUCTURAL: Tie-downs and laced cables were replaced in the right shoulder prior to the test. Also prior to the test it was noticed that the Right shoulder elevation/depression lower rear soft-stop had to be reglued. This came loose again after the test due to improper gluing.

PROCEDURAL: Beginning with the next test, the final pre-test electrical checks were to be taken after ADAM was strapped into the seat and the harness pre-tension adjustments made. This was done to avoid some of the uncertainty regarding when any problem with the ADAM instrumentation might have occurred. This test was rerun as Test 3495.

12. TEST 3495    Cell: B    Subject: ADAM-S    Result: ADAM Success

ELECTRICAL: Excessive noise was present in the Y-Lumbar Moment and the Right Hip Abduction/Adduction data.

STRUCTURAL: Prior to the test, the wire hold down screw securing the left knee potentiometer had to be tightened, although the potentiometer itself remained fixed. A small puncture was observed after the test on the inside skin of the torso due to contact with the corner of the neck block.

13. TEST 3496    Cell: C    Subject: ADAM-S    Result: ADAM Success

ELECTRICAL: An ADAM serial communication link failure occurred during the pre-test electrical check, after ADAM was strapped into the seat. The problem was a loose connection at the CPU board interconnect. This connection may not have been properly tightened during previous ADAM maintenance. A dropout occurred in the Right Lower Leg Torque Positive data. Excessive noise was present in the the Y-Lumbar Moment data. Large negative spikes were present in the data on two channels (DECOM only). The ADACS Lumbar Y Force data was saturated.

STRUCTURAL: Cuts on the inside skin of the lower right back were noticed after the test. These were caused by contact with the sharp corner of the viscera box. The zipper on the left side of the torso continued to pull apart.

14. TEST 3497

Cell: D (+8Gy)    SUBJECT: ADAM-L    Harness: X-90    Result: ADAM Success

ELECTRICAL: The post-test electrical check showed defective Left and Right Lower Leg Torque Negative channels, indicating a problem in the knee load cells. However, the data appeared normal for those channels. The calibration value of the X-Chest Acceleration channel changed by five hex units during the test.

PROCEDURAL: The harness pre-tensions at the hips were unable to be adjusted up to their required levels due to slippage of the straps into the openings between the thighs and hips.

Test-by-Test Narrative (-Gx)

1. Test 3498    Cell: G    Subject: ADAM-L    Result: ADAM Success

ELECTRICAL: The pre-test electrical check showed a defective Left Lower Leg Torque Negative channel (waived). A dropoff occurred in the Right Lower Torque Negative data, and excessive noise was present in both the Left and Right Lower Leg Torque Positive data. Broken wires were repaired in the left and right knee load cells after the test. Large negative spikes were present in the data on three channels (DECOM only). The ADAM internal temperature read 5° C lower than the ADACS temperature.

PROCEDURAL: Prior to the test, ADAM was loading down the start signal. The problem was discovered to be in the hand-held video terminal which had been left in the wrong mode after previous ADAM maintenance. Some position channels were inverted. It was discovered that the slope signs which are used to process the data for the position sensors were all made positive. This was corrected by changing them to the correct signs in the processing file. The harness pre-tensions at the hips were low.

2. TEST 3499    Cell: H    Subject: ADAM-L    Result: ADAM Failure

ELECTRICAL: A dropout occurred in the Head-Z Acceleration data. This was attributed to a wire which was strained during impact. A dropout also occurred in the Left Elbow Flexion and the Left Forearm Supination/Pronation data. A wire in the elbow was repaired after the test. The X-Chest acceleration data showed an unexpectedly large pulse. A loose wire was repaired which was possibly causing the problem.

STRUCTURAL: The ADAM arm zippers needed to be taped prior to the test to avoid separating.

PROCEDURAL: The ADACS temperature measured incorrectly at -258° C due to SRL forgetting to disconnect the ground jumper which was being used to obtain the temperature voltage offset. Thigh inserts were installed but harness pre-tensions at the hips were still low. Several other channels were further out of calibration than expected due to SRL revising some channel sensitivities.

3. TEST 3500      Cell: G      Subject: ADAM-S      Result: No-Test

ELECTRICAL: The pre-test electrical check showed a malfunction in the ADAM to DRASS data transfer. This was caused by a power supply failure on the digital I/O board. The board was replaced and a heat sink installed to prevent a recurrence. A dropout occurred in the Left Lower Leg Torque Negative data (waived for the next two tests). A large spike appeared in the data on several channels at about 250 ms. This was caused by ADAM's head striking the aluminum block above the back rest. The ADAM internal temperature read 18.4° C higher than the ADACS temperature.

STRUCTURAL: The teeth in the zippers on the right and left sides of the torso would not remain locked prior to the test. The Sternoclavicular Elevation/Depression left lower front soft-stop was repaired prior to the test.

PROCEDURAL: A "No-Test" occurred due to no photogrammetric data. This was caused by the switches at the camera station being set incorrectly. A seat cushion was placed in back of ADAM for the remainder of the tests in order to help achieve the desired harness pre-tensions. However, the hip pre-tensions were still low.

4. TEST 3501      Cell: G      Subject: ADAM-S      Result: ADAM Success

ELECTRICAL: The calibration of two channels changed by more than 6 hex units during the test. The large spike at 250 ms caused by ADAM striking his head was still present on several channels. The ADAM internal temperature read 14° C higher than the ADACS temperature.

STRUCTURAL: Damage, possibly from previous tests, was observed in the zipper assemblies after the test in the right and left ankle regions. Damage to the shoulder wire-wrap was also noticed after the test. The torque in the Left Forearm Supination/Pronation joint was binding due to a manufacturer's burr. This was noticed after the test. The right elbow potentiometer connector appeared to need remounting after the test.

PROCEDURAL: The harness pre-tensions at the hips and shoulders were low.

5. TEST 3502      Cell: L      Subject: ADAM-S      Result: No-Test

ELECTRICAL: Excessive noise was present in the the Right Sternoclavicular Elevation/Depression data. A dropoff occurred in the Right Lower Leg Torque Negative data. The ADAM internal temperature read 10° C higher than the ADACS temperature.

PROCEDURAL: A "No-Test" occurred due to no DECOM data. This was caused by the DRASS being incorrectly set in the download position. It was discovered by SRL that several of the position channels had been assigned incorrect slope signs. These were corrected in time for the next test. The harness pre-tensions at the shoulders were low.

6. TEST 3503      Cell: L      Subject: ADAM-L      Result: ADAM Success

ELECTRICAL: The Left Sternoclavicular Pronation/Retraction data was breaking up during the test due to a faulty potentiometer on the transducer board. A large negative spike was present in the X-Lumbar Moment data (DECOM only), and large positive spikes were present in the Lumbar Roll data (DECOM only). A spike occurred in the ADACS data on three channels. The ADACS system was checked after the test and no problem could be located.

STRUCTURAL: Prior to the test, it was discovered that the lockwasher and the indexed flat washer keys in the right shoulder lockwasher assembly were sheared off. The damage was due to the lash or "slop" in the lockwasher. The assembly was repaired and a thrust (or friction) bushing was added to prevent this problem from recurring. After the test, it was noticed that there were small cuts in both the left and right heel skins due to the foot rods puncturing the skin from the inside. This was caused by the impact of the feet striking the sled.

PROCEDURAL: The test was initially aborted when the track lights went out. No problem could be found in the lighting system and ADAM was rechecked and the test completed. The harness pre-tensions at the hips were low.

7. TEST 3504      Cell: M      Subject: ADAM-L      Results: ADAM Success

ELECTRICAL: A possible faulty response occurred in the Left Elbow Flexion data. A broken wire was discovered and repaired. A breakup was still occurring in the Left Sternoclavicular Pronation/Retraction data. A dropoff occurred in the Left Lower Leg Torque Positive data. This channel was waived for the remainder of the large ADAM tests. ADACS offsets occurred on four channels.

STRUCTURAL: After the test, it was noticed that the left shoulder shrug electrical connector was frayed. It was replaced before the next test. The sternoclavicular transducer board assembly was rebuilt after the test.

PROCEDURAL: The seat cushion was noticed to have slipped forward during the test. ADAM was lifted up and the cushion pushed back for the next test.

8. TEST 3505 Cell: M Subject: ADAM-L Result: ADAM Failure

ELECTRICAL: The X-Chest Acceleration data was faulty, caused by a loose wire located near the sensor.

STRUCTURAL: Damage was noticed after the test to the inner skin in the lower right corner of the back. A cut in the front left skin of the pelvis was also noticed, probably caused by the seat strap crushing the skin against the hip clevis.

PROCEDURAL: A short delay occurred prior to the test due to the charge on the DRASS battery being low. During the test, the seat cushion slid forward and had to be repositioned.

9. TEST 3506 Cell: M Subject: ADAM-S Result: ADAM Success

ELECTRICAL: Three of the Lower Leg Torque channels showed defective data (all three waived for next test). The X-Lumbar Acceleration channel calibration changed by five hex units during the test.

STRUCTURAL: Small cuts were noticed on the skin of the left and right heels after the test.

PROCEDURAL: The harness pre-tensions at the shoulders were low.

10. TEST 3507 Cell: M Subject: ADAM-S Result: ADAM Success

ELECTRICAL: Defective data was present on all four Lower Leg Torque channels. Three of these channels had been waived prior to the test. Excessive noise was present in the Lumbar Acceleration data. The ADAM internal temperature read 7.5° C higher than the ADACS temperature.

STRUCTURAL: The wires to the potentiometer for the Right Ankle (abduction/adduction) were disconnected prior to the test to allow for the lockwasher to be inserted after the test.

PROCEDURAL: The harness pre-tensions at the shoulders were low.

11. TEST 3511 Cell: N Subject: ADAM Success

ELECTRICAL: Excessive noise was present in the Lumbar Moment data. This channel was waived for the next test and no defect was found. The Right Ankle abduction data appeared to be faulty, caused by a bad connection to the potentiometer of the X-Lumbar Acceleration channel. Calibration of the X-Lumbar Acceleration channel by five hex units during the test. Broke the potentiometer sensor were



repaired to correct the problem. Broken wires on the Y-Neck Force accelerometer sensor were discovered prior to the test (waived). An unexpectedly large spike appeared in the Right Sternoclavicular Elevation/Depression data. This was checked after the test and no defect was found. The Right Lower Leg Torque Positive channel was repaired prior to the test. The Right and Left Lower Leg Torque Negative channels were waived for this test. Broken wires on the Right Knee Medial/Lateral position sensor were repaired. The ADAM internal temperature read 11° C higher than the ADACS temperature.

**PROCEDURAL:** SRL inadvertently failed to recalibrate the z-axis accelerometers for their maximum range before this test. This was then accomplished prior to the next small ADAM test. The harness pre-tensions at the shoulders were low.

12. TEST 3512      Cell: N      Subject: ADAM-L      Result: ADAM Success

**ELECTRICAL:** The Z-Chest Acceleration channel was found to be defective during an internal ADAM check prior to the test and was waived. A defective Crest Interface Board (CRIB) was determined to be the cause and was replaced prior to the next large ADAM test. The board replacement required the submission of new sensitivities for four ADAM channels. The shape of the response plot of the ADAM Z-Neck Force data was somewhat different than the corresponding ADACS data. Large negative spikes were present in the data (DECOM only) on two channels, and large positive spikes were present on one channel (DECOM only). The calibration of the Y-Lumbar Force and the Z-Lumbar Moment channels changed by five and four hex units, respectively, during the test. The magnitude of the ADACS internal temperature read excessively high due to a large spike in the data.

**STRUCTURAL:** After the test, it was noticed that the zipper on the left side of the torso was separating at the top. The torque in the left wrist flexion/extension joint had to be tightened due to arm lash in the test.

13. TEST 3513      Cell: O      Subject: ADAM-S      Result: ADAM Success

**ELECTRICAL:** Faulty test data was present on all Lower Leg Torque channels. Two of the defective channels were discovered prior to the test and were waived. The defective knee load cells were repaired after the test. Excessive noise was present in the Right Hip Abduction/Adduction data. The calibration of the X-Lumbar Acceleration channel changed by four hex units during the test. The ADAM internal temperature read 9° C higher than the ADACS internal temperature.

**STRUCTURAL:** Skin damage was noted after the test in two places, consisting of a small puncture hole near the left wrist and damage on the left upper leg internal skin. This damage

had occurred in previous tests. Skinned wires in the left shoulder complex and the left upper arm were taped after the test. The Left Shoulder Abduction/Adduction wire sleeve was skinned at the connector which mounted to the chest box. This was caused by a loose tie-down which resulted in scraping against the shoulder yoke as the arms rotated upward.

PROCEDURAL: The harness pre-tensions at the shoulders were low.

14. TEST 3514    Cell: P    Subject: ADAM-S    Result: No-Test

ELECTRICAL: The wiring to the knee load cells was broken during the test causing the data in three of the Lower Leg Torque channels to be defective. Apparently the wires had insufficient slack for the range of leg motion. The X-Neck Moment data was faulty due to a loose wire. Excessive noise was present in the Right Sternoclavicular Elevation/Depression and the Y-Lumbar Acceleration data. These were waived for the next two tests. The ADAM internal temperature read 7° C higher than the ADACS temperature.

STRUCTURAL: A zipper failure was noticed in the right upper leg prior to the test.

PROCEDURAL: A "No-Test" occurred due to a film break in the oblique LOCAM camera. The polarity of the ADAM data in the X-Head Acceleration channel was inverted from the previous small ADAM tests despite the sensitivity parameters being the same for both tests.

15. TEST 3515    Cell: H    Subject: ADAM-S    Result: ADAM Success

ELECTRICAL: Excessive noise was present in the the Right Sternoclavicular Elevation/Depression (waived) and X-Lumbar Acceleration data. Also, some noise was present in the Left Lower Leg Torque Negative data. The calibration of the Y-Lumbar Moment channel changed by six hex units during the test. The ADAM internal temperature read 9° C higher than the ADACS temperature.

STRUCTURAL: The tie-wrap around the neck wires was pulled off during the test due to the motion of the head.

16. TEST 3516    Cell: H    Subject: ADAM-S    Result: No-Test

ELECTRICAL: Excessive noise was present in the Right Hip Abduction/Adduction data, and continued to be present for most of the remaining small ADAM tests. The shape of the response plot of the ADAM Y-Neck Moment data was somewhat different than for the corresponding ADACS data. The ADAM internal temperature read 8° C higher than the ADACS temperature. A "No-Test" occurred due to faulty ADACS Head/Neck Z Force data. The problem was caused by a shield to system ground short.

STRUCTURAL: The left shoulder cover came off during this and one other small ADAM test.

PROCEDURAL: The harness pre-tensions at the hips and shoulders were low.

17. TEST 3517 Cell: I Subject: ADAM-L Result: ADAM Success

ELECTRICAL: Prior to the test, the Left Lower Leg Torque Positive channel was determined to be faulty (waived). Large negative spikes were present in the data on one RAM and two DECOM channels, and large positive spikes were present on one DECOM channel. Excessive noise was present in the Z-Chest Acceleration data. The Y-Lumbar Moment data saturated at 3300 in-lbs during this test and continued to saturate at this same level during the remaining large ADAM tests. The cause appeared to be in the inability of the load cell transducer to measure forces more than 10% greater than its rated value of  $\pm 3000$  lb-in. The ADAM internal temperature read 6° C higher than the ADACS temperature. The ADACS Head/Neck Z Force data showed an offset of -200 lbs and the shape of the response plot was somewhat different than the corresponding ADAM plot.

18. TEST 3518 Cell: I Subject: ADAM-L Result: ADAM Failure

ELECTRICAL: The Z-Neck Force data showed an excessively high peak magnitude. The problem appeared to be located near the sensor connection. Dropouts were present in the Right Sternoclavicular Pronation/Retraction data. The cause was a pinched wire which was repaired, insulated, and repositioned. A breakup and dropout occurred in the Left Elbow Flexion data. A board connector and short cable were replaced. The ADAM internal temperature read 9° C higher than the ADACS temperature.

PROCEDURAL: The harness pre-tensions at the hips were low.

19. TEST 3519 Cell: I Subject: ADAM-S Result: ADAM Success

ELECTRICAL: Excessive noise was present in the Right Sternoclavicular Elevation/Depression data. The ADAM internal temperature read 9° C higher than the ADACS temperature.

PROCEDURAL: The harness pre-tensions at the hips and shoulders were low.

20. TEST 3520 Cell: I Subject: ADAM-S Result: ADAM Success

ELECTRICAL: Excessive noise was present in the Y-Lumbar Moment data. The ADAM internal temperature read 6° C higher than the ADACS temperature. The ADACS Neck MY Torque data showed a -60 lb. offset.

STRUCTURAL: Damage to the shoulder viscera tie-down was noticed after the test. Damage occurred to the upper part of the

restraint harness. The harness was subsequently replaced after the test.

PROCEDURAL: The harness pre-tensions at the hips and shoulders were low.

21. TEST 3521      Cell: J      Subject: ADAM-L      Result: No-Test/  
ADAM Failure

ELECTRICAL: The Z-Neck Force data was saturated due to a broken wire in the channel's negative excitation line. A dropout occurred in the Y-Head Acceleration data due to a bad wire. Excessive noise was present in the Y-Lumbar Acceleration data. The Left Lower Leg Torque Positive and Left Lower Leg Torque Negative data were faulty due to broken wires in the knee load cell. These channels were waived for the remainder of the large ADAM tests. An ADACS failure occurred due to a 70 ms data dropout occurring after impact, but the data was able to be processed up to the point of the dropout. The cause appeared to be broken connections in the whip cable. The ADACS internal temperature read excessively high at -253° C (See Test 3499).

STRUCTURAL: A left elbow bushing was loose prior to the test. This part was determined to have had a manufacturer's defect and was replaced. Damage was noticed at the top half of the X-Band 90 harness and at the lower half of the harness at the "D" ring. The harness was replaced after the test.

PROCEDURAL: A "No-Test" was declared due to a jam in the oblique LOCAM camera as well as the ADACS failure. The harness pre-tensions at the hips and shoulders were low.

22. TEST 3523      Cell: J      Subject: ADAM-S      Result: No-Test/  
ADAM Failure

ELECTRICAL: The ADAM data was unusable due to a large spike occurring at about 60 ms. Also causing interference were 75 Hz sine and 100 Hz square waves which appeared in the data on some channels after the spike. A large spike was present in the ADACS Internal Temperature data making comparison with the ADAM temperature data difficult.

PROCEDURAL: A "No-Test" occurred due to a jam in the oblique LOCAM camera. The harness pre-tensions at the hips were low.

23. TEST 3524      Cell: J      Subject: ADAM-S      Result: ADAM Success

ELECTRICAL: The Right Lower Leg Torque Positive channel checked bad in the electrical pre-test (waived). The Lumbar Roll channel also checked bad in the electrical pre-test (waived). The problem appeared to be in a printed circuit connection which was resoldered after the test. A dropoff occurred in the Right Hip Flexion data (waived). The ADAM internal

temperature read 9° C higher than the ADACS temperature. A large positive spike was present in the data in several ADACS channels at about 230 ms.

STRUCTURAL: The right and left shoulder flexion assemblies were removed and inspected prior to the test.

PROCEDURAL: The LOCAM camera system was switched to the photosonic system for this test and beyond to avoid any future camera jams. The harness pre-tensions at the left hip and right shoulder were low.

24. TEST 3525    Cell: J    Subject: ADAM-L    Result: ADAM Failure

ELECTRICAL: The Z-Neck Force data was saturated. The cause was a defective head/neck z-axis load cell. The defective cell was replaced with the one from the small ADAM prior to the next large ADAM test. Excessive noise was present in the Y-Lumbar Acceleration data. A dropoff occurred in the Right Hip Flexion data. The load cell for the Y-Lumbar Moment channel was recalibrated prior to the test but the test data was still saturated at 3300 lb-in. The magnitude of the ADACS internal temperature data was excessively high at -255° C (see Test 3499).

PROCEDURAL: The RAM data needed to be reprocessed due to the failure of SRL to submit the new Y-Lumbar Moment sensitivities in time for the first processing. A camera ran out of film 1 second before the test, causing an abort. A harness tear was found after the test. The harness pre-tensions at the hips were low.

25. TEST 3526    Cell: K    Subject: ADAM-S    Result: ADAM Failure

ELECTRICAL: No DECOM data were available after the test. The cause was not determined. The Right Lower Leg Torque Negative and Left Lower Leg Torque Positive data appeared to be faulty. The Right Hip Flexion (waived) and Lumbar Roll data were defective. The cause was unknown. The ADAM internal temperature read 4° C higher than the ADACS temperature.

PROCEDURAL: The harness pre-tensions at the hips and shoulders were low.

26. TEST 3527    Cell: K    Subject: ADAM-L    Result: ADAM Success

ELECTRICAL: After the test it was noticed that the Lumbar Roll and Hip Flexion sensors had no positive excitation. The Right Hip Medial/Lateral position sensor had an intermittent wiring problem which was noticed after the test. The ADAM internal temperature read 11° C higher than the ADACS temperature.

STRUCTURAL: After the test it was noticed that two screws to the position sensor for the Right Sternoclavicular Elevation/Depression were loose, although the sensor itself remained

stationary. The sternoclavicular pronation/retraction potentiometer blade had some slight movement due to a lack of hot melt glue. This could have prevented the sensor from registering its full range.

**PROCEDURAL:** The ADAM data had to be reprocessed since the Z-Neck Force and Z-Neck Moment sensitivities changed due to replacement of the head/neck load cell. The harness pre-tensions at the hips and shoulders were low.

## DISCUSSION

### Structural Adequacy of ADAM

The ADAMs successfully completed the test program with no permanent deformation or failures of major structural components. Only one minor mechanical problem was noted during testing.

The clevis which allows the ADAM's arm to swing is fastened to the shoulder stud by means of a locknut, under which are a lockwasher and flat washer. There is some clearance between the sides of the stud keyway and the keys on the washers. Under the force of the tests, friction between the clevis and flatwasher causes the washers to rotate. The wear and impact deteriorated the keys until they failed.

This effect was noted prior to test 3503 for the large ADAM and after test 3507 for the small ADAM.

To solve the problem an Oillite<sup>TM</sup> (oil impregnated bronze alloy) bushing was placed between the shoulder clevis and the flat washer. This reduced the friction in the joint and no further problems were noted for the remainder of the test program.

### Comparison of the Dynamic Response of ADAM With Human Subjects

No human response data are yet available to allow a comparison of ADAM and human response to +Gy impact, but a program to obtain the necessary data is planned for the future.

Human response data for 10 G impacts in the -x direction using prototype X-Band 90° and X-Band 45° harnesses in a CREST configuration are available and are summarized in Appendix C. These data were used to evaluate the ability of the ADAMs to simulate human dynamic response.

The following quantities measured during the tests were used to compare ADAM and human dynamic response:

1. Maximum x-axis chest acceleration (external accelerometers).
2. Time-to-peak x-axis chest acceleration (measured from initiation of impact).
3. Maximum z-axis chest acceleration (external accelerometer).
4. Time-to-peak for item 3.
5. Maximum x-axis head acceleration (internal sensor for ADAM, external for humans).
6. Time-to-peak for item 5.
7. Maximum combined shoulder anchor load.
8. Time-to-peak for item 7.
9. Maximum right horizontal anchor resultant load.
10. Time-to-peak for item 9.

Items 7 and 9 showed a fair correlation with subject weight. For these, a least squares line was drawn through the human data with 95% confidence bands. The ADAM data were then plotted on the same axes to allow a visual

determination of how well the ADAM data matched the human data. Figures 8 and 9 show this comparison for each of the two harness types. Maximum right vertical anchor load vs. subject weight is also plotted for completeness, though it cannot be used to judge the ADAM simulation of human response. This is because this anchor was pretensioned in the human tests but slack in the ADAM tests. The results are not comparable.

The other items showed a poor correlation with subject weight and were taken as independent of it. A Gaussian distribution was assumed instead. Mean ( $\bar{x}$ ) and upper and lower confidence limits ( $\pm 2$  standard deviation) were calculated for the human data and tabulated with the ADAM data for comparison.

TABLE 2. MAXIMUM X-AXIS CHEST ACCELERATION

HUMAN	X-Band 90	X-Band 45
$\bar{X} + 2S$	-9.9 G	-8.7 G
$\bar{X}$	-13.8 G	-14.7 G
$\bar{X} - 2S$	-17.7 G	-20.7 G
Small ADAM	-11.6 G	-11.0 G
Large ADAM	-15.8 G	-11.3 G

The ADAM results show a good fit with the human data.

TABLE 3. TIME-TO-PEAK X-AXIS CHEST ACCELERATION

HUMAN	X-Band 90	X-Band 45
$\bar{X} + 2S$	98.1 msec	104.5 msec
$\bar{X}$	86.4 msec	86.4 msec
$\bar{X} - 2S$	74.6 msec	68.3 msec
Small ADAM	77.0 msec	73.0 msec
Large ADAM	84.0 msec	94.0 msec

The ADAM results show a good fit with the human data.



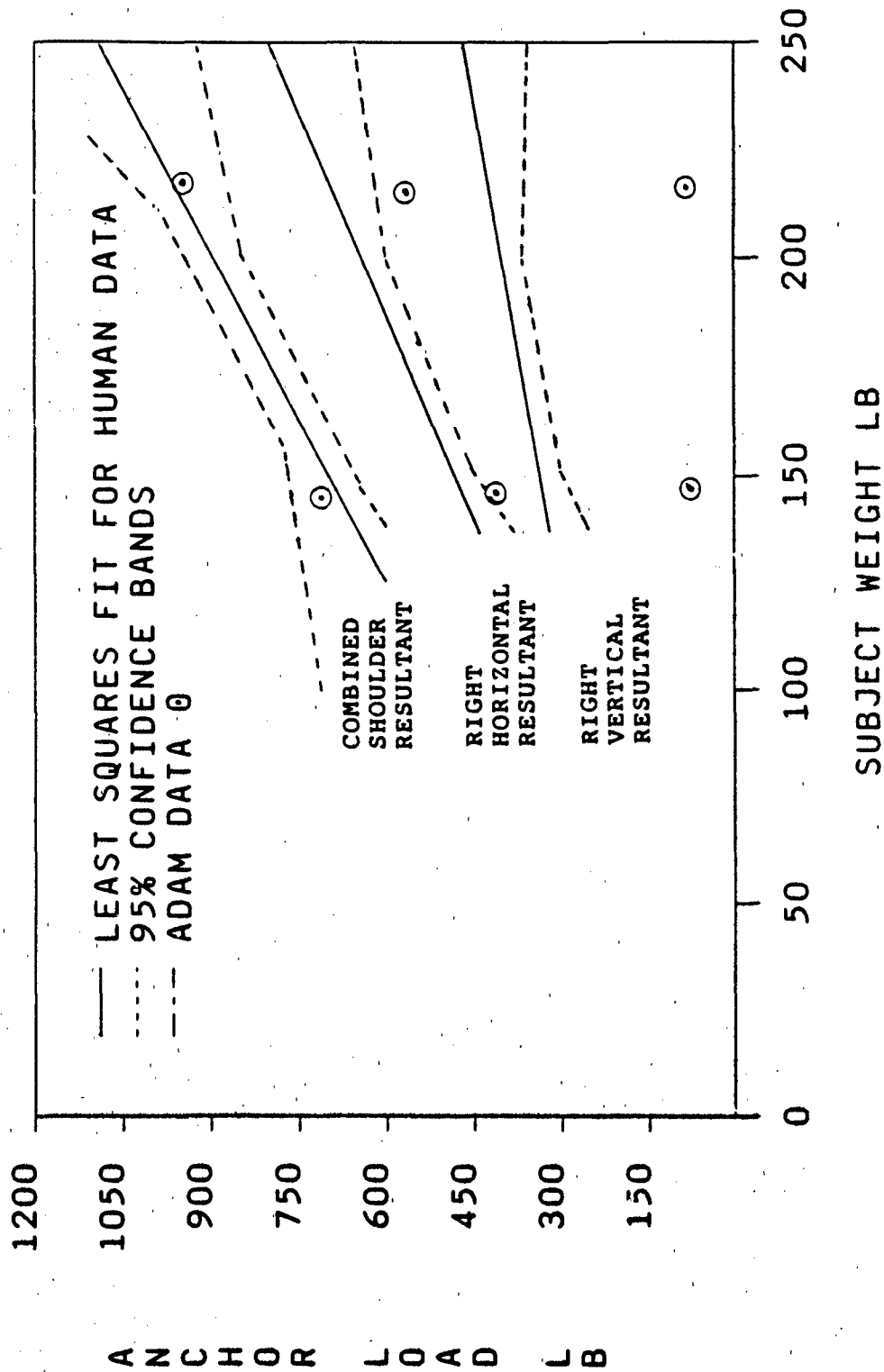


FIGURE 8: ANCHOR LOADS VERSUS SUBJECT WEIGHT  
 FOR HUMAN AND ADAM SUBJECTS  
 (X-BAND 90 HARNESS)

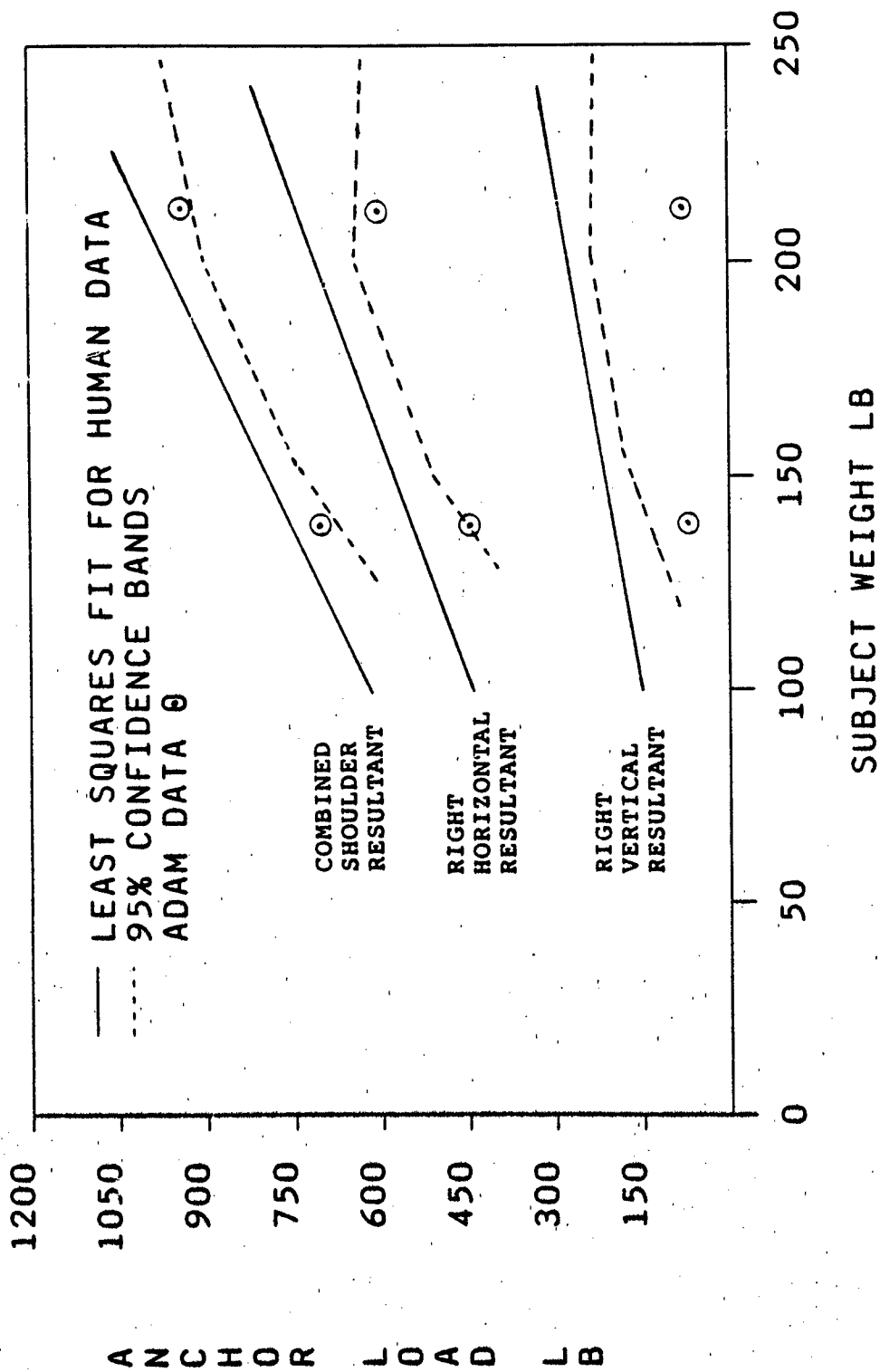


FIGURE 9: ANCHOR LOADS VERSUS SUBJECT WEIGHT  
 FOR HUMAN AND ADAM SUBJECTS  
 (X-BAND 45 HARNESS)

TABLE 4. MAXIMUM Z-AXIS CHEST ACCELERATION

HUMAN	X-Band 90°	X-Band 45°
$\bar{X} + 2S$	16.5 G	20.5 G
$\bar{X}$	11.0 G	13.1 G
$\bar{X} - 2S$	5.5 G	5.7 G
Small ADAM	12.2 G	16.1 G
Large ADAM	13.7 G	12.6 G

The ADAM results show a good fit with the human data.

TABLE 5. TIME-TO-PEAK Z-AXIS CHEST ACCELERATION

HUMAN	X-Band 90°	X-Band 45°
$\bar{X} + 2S$	130.7 msec	137.7 msec
$\bar{X}$	93.6 msec	99.3 msec
$\bar{X} - 2S$	56.5 msec	60.9 msec
Small ADAM	68.0 msec	73.0 msec
Large ADAM	85.0 msec	84.0 msec

The ADAM results show a good fit with the human data.

TABLE 6. MAXIMUM X-AXIS HEAD ACCELERATION

HUMAN	X-Band 90°	X-Band 45°
$\bar{X} + 2S$	-6.9 G	-7.3 G
$\bar{X}$	-10.2 G	-10.8 G
$\bar{X} - 2S$	-13.4 G	-14.3 G
Small ADAM	-18.0 G	-18.2 G
Large ADAM	-16.1 G	-15.4 G

The ADAMs, particularly the small ADAM, show a poor fit with the human data. The ADAM accelerometer is more rigidly mounted and may be located at a greater radius from the axis of rotation than the mouth-pack accelerometer used in the human tests. However, it is unlikely that these factors affect the results to a significant degree.

TABLE 7. TIME-TO-PEAK X-AXIS HEAD ACCELERATION

HUMAN	X-Band 90°	X-Band 45°
$\bar{X} + 2S$	132.7 msec	117.0 msec
$\bar{X}$	106.6 msec	96.4 msec
$\bar{X} - 2S$	80.5 msec	75.8 msec
Small ADAM	104.0 msec	103.0 msec
Large ADAM	105.0 msec	102.0 msec

The ADAM results show a good fit with the human data.

#### ITEM 7. MAXIMUM COMBINED SHOULDER ANCHOR LOAD

Figure 8 shows graphically that the ADAM data matches the human data very well for the X-Band 90° harness. The results are reasonable for the X-Band 45° harness.

TABLE 8. TIME-TO-PEAK FOR MAXIMUM COMBINED SHOULDER ANCHOR LOAD

HUMAN	X-Band 90°	X-Band 45°
$\bar{X} + 2S$	99.9 msec	93.8 msec
$\bar{X}$	94.3 msec	88.2 msec
$\bar{X} - 2S$	88.7 msec	82.6 msec
Small ADAM (x-axis)	78.5 msec	77.0 msec
Large ADAM (x-axis)	91.5 msec	86.0 msec

The large ADAM shows a good fit with the human data. The small ADAM does not, probably because of the problem with getting adequate shoulder preloads with the small ADAM.

#### ITEM 9. MAXIMUM RIGHT HORIZONTAL ANCHOR RESULTANT LOAD

Figures 8 and 9 show that the ADAM data fit the human results poorly. The correlation coefficient for the X-Band 45° line is low, causing it to have larger confidence bands than that for the X-Band 90° harness.

TABLE 9. TIME-TO-PEAK HORIZONTAL ANCHOR RESULTANT LOAD

HUMAN	X-Band 90°	X-Band 45°
$\bar{X} + 2S$	89.4 msec	93.3 msec
$\bar{X}$	83.1 msec	86.9 msec
$\bar{X} - 2S$	76.8 msec	80.5 msec
Small ADAM	85.0 msec	77.0 msec
Large ADAM	95.0 msec	87.0 msec

The small ADAM shows a good fit with the human data for the X-Band 90° harness and a poor fit for the X-Band 45° harness. The reverse is true for the large ADAM. The large ADAM response in the X-Band 90° may be slowed by the tubes of the harness attachment pressing into its sides. In the X-Band 45° harness, the slack in the vertical anchor may have had a larger effect on the small ADAM than the large ADAM.

Though the head accelerations are too high and the hip anchor forces too low, overall the ADAM data match the human data well. Two cautionary notes are required. First, the conclusions are drawn from a single test of each ADAM with each harness, so it is unclear if the ADAM test results are representative of average response. Second, for those items which show a poor match between ADAM and human data, it is not clear how much of the difference in response is due to differences in the test setup rather than differences between ADAM and human response.

#### Accuracy of ADAM Instrumentation

##### DECOM/RAM

Wilcoxon Signed Rank tests were performed in order to compare the ADAM RAM and DECOM systems. These tests used differences between the paired data of the two systems to test for differences between the means. The variables tested were peak magnitude and time-to-peak for the nine "critical channels". No significant differences were found between any of the RAM and DECOM data in either the small or the large ADAM ( $\alpha = 0.05$ ).

##### Small ADAM RAM

Small ADAM peak magnitude and time-to-peak offset-adjusted data are shown in tables 10-13 for both the RAM and ADACS systems. All data are  $n=1$  unless the G-level is followed by (2), indicating the data is the mean for  $n=2$ . RAM data deviating more than  $\pm 5\%$  from the ADACS data are followed by an asterisk, with the percentage of the data deviations summarized in Table 14. Only the RAM Head Y Acceleration, Head Z Acceleration, and Neck Y Force data (+Gy), and the Head X Acceleration and Neck X Force data (-Gx), demonstrated consistent accuracy in the peak magnitude measurements. The RAM time-to-peak data, however, was consistently close to the ADACS data on all 8 channels, with the exception of the Lumbar Y Force (+Gy).

CHANNEL (+Gy)

HEAD Y ACCEL ( )  
 HEAD Z ACCEL ( )  
 CHEST Y ACCEL  
 LUMBAR Y ACCEL  
 NECK Y FORCE  
 NECK Z FORCE  
 LUMBAR Y FOR  
 LUMBAR Y FOR 20.5\*  
 NECK MX TORQ 128/686\*

HEAD Y ACCEL	119/121
HEAD Z ACCEL	88/89
CHEST Y ACCEL	77/79
LUMBAR Y ACCEL ( )	61/62
NECK Y FORCE (MS)	129/128
NECK Z FORCE (MS)	124/127
LUMBAR Y FORCE (MS)	119/118
LUMBAR Y FORCE (-MS)	52/39*
NECK MX TORQ (MS)	127/129

\*RAM data deviating more than  $\pm 5\%$  from ADACS data

TABLE 11  
 SMALL ADAM ADACS/RAM +Gy DATA  
 X-BAND 90° HARNESS

CHANNEL (+Gy)	8G	11G	14G
HEAD Y ACCEL (G)	14.5/14.7	25.0/24.9	34.2/34.4
HEAD Z ACCEL (-G)	15.3/16.4*	25.3/25.4	37.3/36.8
CHEST Y ACCEL (G)	17.1/16.1*	24.8/23.1*	29.0/28.5
LUMBAR Y ACCEL (G)	23.3/25.3*	36.3/39.6*	36.8/39.1*
NECK Y FORCE (-LB)	117/174	189/195	246/256
NECK Z FORCE (LB)	161/181*	368/389*	491/474
LUMBAR Y FORCE (-LB)	1719/908*	2177/1164*	1652/944*
NECK MX TORQ (LB*IN)	268/429*	628/652	824/797
HEAD Y ACCEL (MS)	129/135	125/126	118/119
HEAD Z ACCEL (MS)	92/95	90/91	89/91
CHEST Y ACCEL (MS)	79/79	78/79	71/73
LUMBAR Y ACCEL (MS)	73/76	60/61	53/55
NECK Y FORCE (MS)	130/133	125/126	115/116
NECK Z FORCE (MS)	93/94	123/111*	116/116
LUMBAR Y FORCE (MS)	69/72	59/60	49/51
NECK MX TORQ (MS)	136/135	128/121*	115/118

\*RAM data deviating more than  $\pm 5\%$  from ADACS data

TABLE 12  
SMALL ADAM ADACS/RAM -Gx DATA  
X-BAND 45° HARNESS

CHANNEL (-Gx)	10G	20G (2)	30G	40G
HEAD X ACCEL (-G)	18.8/18.4	45.5/46.2	62.4/61.9	93.0/94.2
HEAD Z ACCEL (-G)	8.8/8.1*	24.0/24.5	47.5/51.0*	72.9/74.7
CHEST X ACCEL (-G)	15.1/15.5	29.6/30.6	50.0/60.3*	61.8/60.3
LUMBAR X ACCEL (-G)	13.6/13.8	36.9/38.5	55.5/61.7*	74.7/84.4*
NECK X FORCE (LB)	164/157	411/398	562/559	866/833
NECK Z FORCE (LB)	54.5/63.1*	188/207*	403/450*	622/660*
LUMBAR X FORCE (-LB)	72.6/147*	249/227*	586/559	1127/1119
NECK MY TORQ (LB*IN)	147/139*	381/358*	703/616*	834/808
<hr/>				
HEAD X ACCEL (MS)	103/104	84/85	72/74	66/68
HEAD Z ACCEL (MS)	84/81	71/73	74/75	55/57
CHEST X ACCEL (MS)	68/69	54/56	46/46	41/42
LUMBAR X ACCEL (MS)	72/73	58/59	46/47	40/42
NECK X FORCE (MS)	104/102	83/83	72/72	65/68
NECK Z FORCE (MS)	253/87*	94/96	76/76	67/73*
LUMBAR X FORCE (MS)	93/90	80/78	71/70	63/66
NECK MY TORQ (MS)	95/95	77/77	65/65	60/62

\*RAM data deviating more than  $\pm 5\%$  from ADACS data

Table 15 shows the results of Wilcoxon Signed Rank tests comparing the small ADAM RAM and ADACS data, with levels of statistical significance in parentheses. Significant differences between 5% and 10% were present between the RAM and ADACS in the peak magnitude of the Lumbar Y Acceleration and Neck Y Force data (+Gy), and in the Chest X and Lumbar X Acceleration data (-Gx). The peak magnitude of the Lumbar Y Force data (+Gy) showed a large difference between the two systems (-45%), although not enough data were present to infer statistical significance. In the time-to-peak measurements, only the RAM Neck Z Force data (-Gx) deviated more than 5% from the ADACS data.

Graphical comparisons of small ADAM RAM and ADACS peak magnitude mean data as a function of carriage (sled) acceleration level are shown in Figures 10 and 11. The data were obtained by averaging measurements from the X-Band 45° and X-Band 90° harness tests. Large deviations between the two systems can be observed in the Lumbar Y Acceleration, Neck Y Force, Lumbar Y Force, and Neck MX Torque +Gy plots. The -Gx RAM curves, however, appear to match the ADACS curves fairly well for all eight channels, with the exception of the Chest X Acceleration and Lumbar X Acceleration data at 45 G.

The general shape of the small ADAM dynamic response plots in both the +Gy and -Gx tests appeared to match the shape of the corresponding ADACS plots closely. Most of the significant differences between the ADAM and ADACS peak magnitude listed in tables 10-13 occurred during tests where a relatively fast rise or fall time was present in the dynamic response. One possible explanation for the differences is in the different types of filtering in the two systems. The ADACS system consists of a low-pass four-pole 120 Hz Butterworth filter while both ADAMs employ low-pass eight-pole 200 Hz Butterworth filters. Another possible reason for the differences is that while the two systems both sampled data at 1000

samples/sec on all channels, the sampling time was not fully synchronized between the two systems. Also, the resolution of the ADAM A/D conversion employed only 8 bits as compared to 11 bits for the ADACS system. The significant differences in the time-to-peak data, however, did not appear to be due to any differences between the two systems in measuring time-to-peak, but usually resulted when slight variations between the response plot shapes as discussed above, caused the two systems to read different peaks as maximum.

TABLE 13  
SMALL ADAM ADACS/RAM -Gx DATA  
X-BAND 90° HARNESS

CHANNEL (-Gx)	10G (2)	20G (2)	30G (2)
HEAD X ACCEL (-G)	18.8/19.4	41.7/40.9	75.5/75.7
HEAD Z ACCEL (-G)	8.3/10.6*	25.4/25.4	51.2/51.9
CHEST X ACCEL (-G)	13.3/14.3*	29.8/30.1	40.7/40.7
LUMBAR X ACCEL (-G)	14.7/15.3	39.5/40.6	57.4/58.5
NECK X FORCE (LB)	160/174*	370/355	711/696
NECK Z FORCE (LB)	—	164/170	448/418*
LUMBAR X FORCE (-LB)	69.0/76.7*	445/463	1015/967
NECK MY TORQ (LB*IN)	145/123*	147/139*	344/336
HEAD X ACCEL (MS)	104/105	84/85	75/76
HEAD Z ACCEL (MS)	157/240*	82/83	61/62
CHEST X ACCEL (MS)	71/71	54/54	46/48
LUMBAR X ACCEL (MS)	78/79	57/58	50/51
NECK X FORCE (MS)	104/103	84/86	75/76
NECK Z FORCE (MS)	—	98/99	81/82
LUMBAR X FORCE (MS)	94/89*	85/84	77/78
NECK MY TORQ (MS)	96/97	89/90	71/71
CHANNEL (-Gx)	40G	45G	
HEAD X ACCEL (-G)	82.2/83.7	120/122	
HEAD Z ACCEL (-G)	64.9/62.2	96.0/85.6*	
CHEST X ACCEL (-G)	50.4/51.1	67.7/92.2*	
LUMBAR X ACCEL (-G)	73.2/76.3	87.8/97.4*	
NECK X FORCE (LB)	790/771	1141/1136	
NECK Z FORCE (LB)	609/597	953/937	
LUMBAR X FORCE (-LB)	435/399	2191/2147	
NECK MY TORQ (LB*IN)	388/370	722/785*	
HEAD X ACCEL (MS)	71/72	65/66	
HEAD Z ACCEL (MS)	58/58	54/55	
CHEST X ACCEL (MS)	76/76	41/42	
LUMBAR X ACCEL (MS)	46/48	40/42	
NECK X FORCE (MS)	71/72	65/66	
NECK Z FORCE (MS)	76/78	68/69	
LUMBAR X FORCE (MS)	73/70	67/69	
NECK MY TORQ (MS)	67/68	62/63	

\*RAM data deviating more than  $\pm 5\%$  from ADACS data



TABLE 14  
PERCENT SMALL ADAM RAM DATA  
WITHIN 5% OF ADACS DATA

CHANNEL (+Gy)	PEAK MAG	TIME-TO-PEAK
HEAD Y ACCEL	100%	100%
HEAD Z ACCEL	83%	100%
CHEST Y ACCEL	50%	100%
LUMBAR Y ACCEL	0%	100%
NECK Y FORCE	100%	83%
NECK Z FORCE	50%	83%
LUMBAR Y FORCE	17%	67%
NECK MX TORQUE	67%	83%
CHANNEL (-Gx)		
HEAD X ACCEL	100%	100%
HEAD Z ACCEL	56%	89%
CHEST X ACCEL	67%	100%
LUMBAR X ACCEL	67%	100%
NECK X FORCE	89%	100%
NECK Z FORCE	38%	75%
LUMBAR X FORCE	67%	89%
NECK MY TORQUE	33%	100%

TABLE 15  
WILCOXON SIGNED RANK TEST SUMMARIES FOR  
SMALL ADAM RAM VS. ADACS DATA

CHANNEL (+Gy)	PEAK MAG	TIME-TO-PEAK
HEAD Y ACCEL	-0.4% (NSD)	+1.6% (.10)
HEAD Z ACCEL	+1.1% (NSD)	+2.0% (.10)
CHEST Y ACCEL	-2.8% (NSD)	+1.9% (NSD)
LUMBAR Y ACCEL	+9.5% (.10)	+2.6% (.10)
NECK Y FORCE	+9.5% (.10)	0.0% (NSD)
NECK Z FORCE	-0.6% (NSD)	-1.7% —
LUMBAR Y FORCE	-45.4% —	-1.8% —
NECK MX TORQUE	+3.1% (NSD)	+0.0% —
CHANNEL (-Gx)		
HEAD X ACCEL	+0.7% (NSD)	+1.6% (.05)
HEAD Z ACCEL	+0.5% (NSD)	+16.0% (.05)
CHEST X ACCEL	+8.3% (.05)	+1.7% (.05)
LUMBAR X ACCEL	+7.4% (.05)	+2.9% (.05)
NECK X FORCE	-2.0% (.05)	-0.7% (NSD)
NECK Z FORCE	+1.1% (NSD)	-14.2% (NSD)
LUMBAR X FORCE	-1.7% (NSD)	-0.7% (NSD)
NECK MY TORQUE	-3.2% (.10)	+1.1% (.05)

#### Large ADAM RAM

Large ADAM peak magnitude and time-to-peak data are shown in tables 16-19 for both the RAM and ADACS systems, with the percentage of RAM data within

SMALL ADAM, +GY

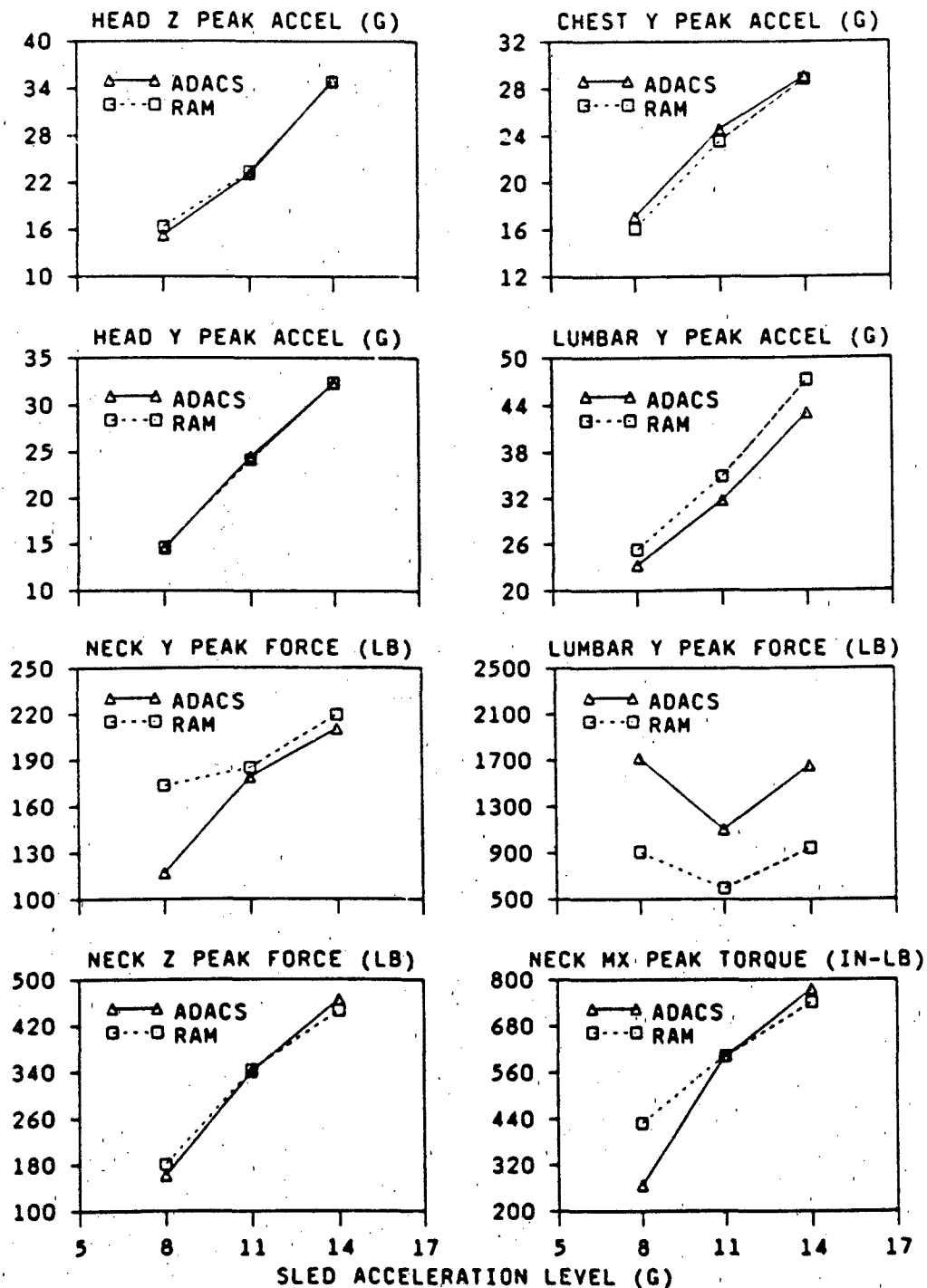


FIGURE 10. SMALL ADAM +Gy DYNAMIC RESPONSES VS. CARRIAGE ACCELERATION

SMALL ADAM, -GX

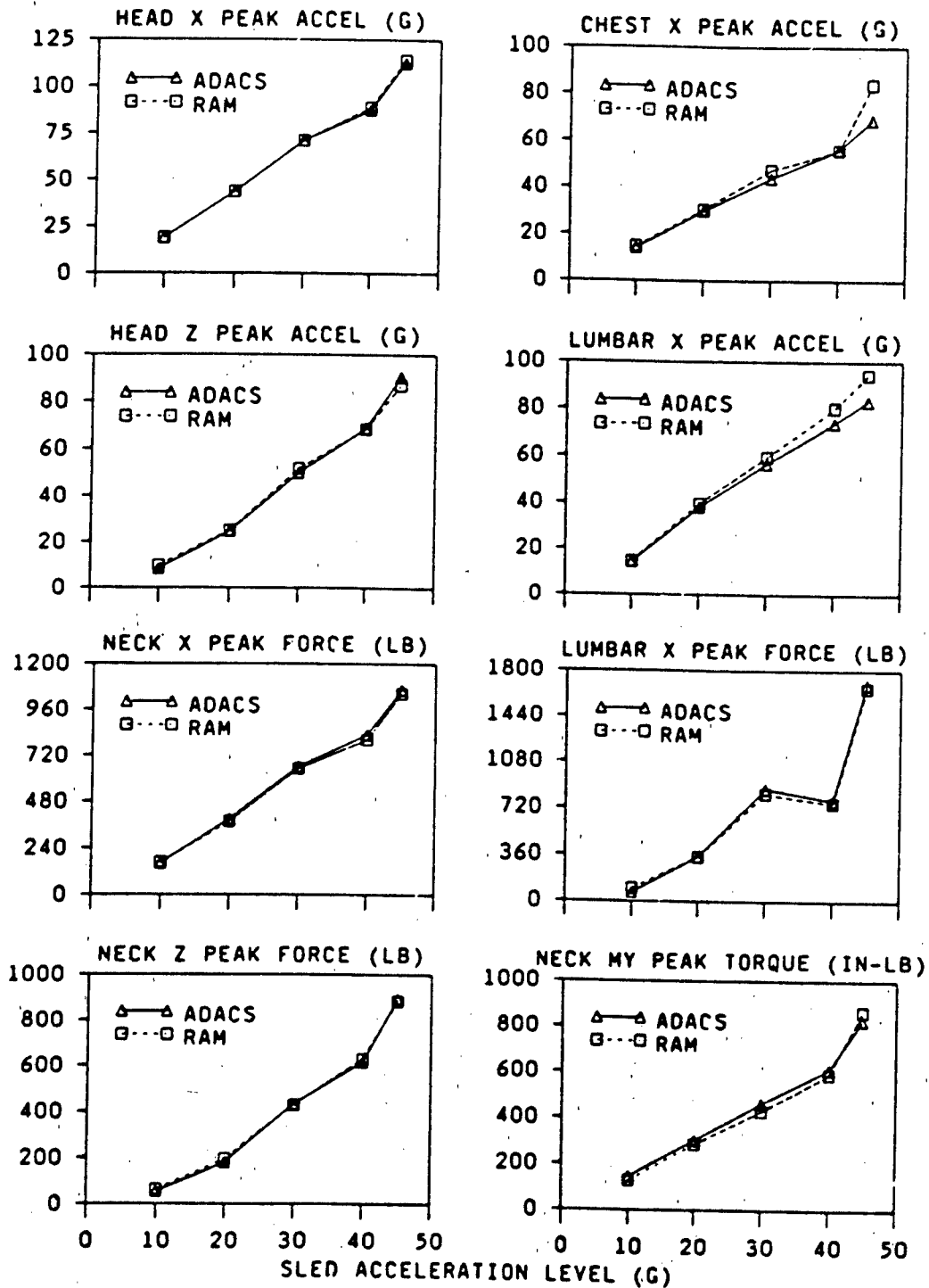


FIGURE 11. SMALL ADAM -GX DYNAMIC RESPONSES VS. CARRIAGE ACCELERATION

5% of the ADACS data summarized in Table 20. The RAM system was consistently accurate in measuring the +Gy peak magnitude data in all 8 channels with the exception of the Lumbar Y Force. The RAM peak magnitude data in the -Gx tests, however, were consistently close to the ADACS data in only the Head X Acceleration, Lumbar X Force, and Neck X Force channels. The Neck Z Force data was particularly inaccurate, with none of the measured RAM data occurring within 5% of the ADACS data. As in the small ADAM, the large ADAM RAM time-to-peak data were fairly close to the corresponding ADACS data in all channels, with the exception of the Lumbar Y Force (+Gy) and the Neck Z Force (-Gx).

Table 21 shows the results of Wilcoxon Signed Rank tests comparing the mean of the large ADAM RAM and ADACS data, with levels of statistical significance in parentheses. No significant differences greater than 5% were present between the RAM and ADACS in any of the +Gy data. Significant differences between 5% and 10%, however, were present in the -Gx peak magnitude of the Chest X Acceleration, Lumbar X Acceleration, and Neck MY Torque data. In the time-to-peak measurements, no RAM data deviated more than 5% from the corresponding ADACS data.

Graphical comparisons of large ADAM RAM and ADACS peak magnitude mean data as a function of carriage (sled) acceleration level are shown in Figures 12 and 13. The RAM data curves appear to fit the ADACS curves fairly closely for both the +Gy and the -Gx data in all 8 channels, with the exception of the Lumbar Y Force (+Gy), Chest X Acceleration (-Gx), and Lumbar X Acceleration (-Gx) curves, which all tend to show somewhat larger RAM values at the higher G-levels.

As was the case with the small ADAM, the general shapes of the large ADAM response plots in both the +Gy and -Gx tests appear to closely match the ADACS. Also, the significant differences between the ADAM and ADACS peak magnitude and time-to-peak listed in tables 16-19 usually occurred during tests where a fast rise or fall time was present in the response data.

TABLE 16  
LARGE ADAM ADACS/RAM +Gy DATA  
X-BAND 45° HARNESS

CHANNEL (+Gy)	8G	11G	14G
HEAD Y ACCEL (G)	16.0/15.7	22.8/22.3	27.6/28.1
HEAD Z ACCEL (-G)	20.0/19.8	34.4/33.3	49.4/49.1
CHEST Y ACCEL (G)	18.5/18.9	26.2/26.4	29.7/29.3
LUMBAR Y ACCEL (G)	22.4/22.2	34.7/35.3	45.1/44.9
NECK Y FORCE (-LB)	176/172	255/239*	335/344
NECK Z FORCE (LB)	200/193	361/366	522/519
LUMBAR Y FORCE (-LB)	84.8/90.5*	169/162	320/349*
NECK MX TORQ (LB*IN)	562/569	773/750	973/956
HEAD Y ACCEL (MS)	127/128	127/127	117/120
HEAD Z ACCEL (MS)	105/106	99/100	91/92
CHEST Y ACCEL (MS)	97/101	89/91	80/79
LUMBAR Y ACCEL (MS)	77/78	72/72*	63/64
NECK Y FORCE (MS)	130/122*	123/119	116/118
NECK Z FORCE (MS)	105/103	100/99	92/92
LUMBAR Y FORCE (MS)	69/64*	66/64	59/61
NECK MX TORQ (MS)	125/127	117/117	120/121

\*RAM data deviating more than  $\pm 5\%$  from ADACS data

TABLE 17  
LARGE ADAM ADACS/RAM +Gy DATA  
X-BAND 90° HARNESS

CHANNEL (+Gy)	8G	11G	14G
HEAD Y ACCEL (G)	17.4/17.5	21.1/21.1	24.1/24.3
HEAD Z ACCEL (-G)	23.5/22.9	36.0/36.0	40.4/39.3
CHEST Y ACCEL (G)	17.6/17.5	27.3/27.3	28.4/28.3
LUMBAR Y ACCEL (G)	17.9/18.1	22.9/22.6	36.1/36.6
NECK Y FORCE (-LB)	186/193	253/257	285/278
NECK Z FORCE (LB)	242/246	343/334	404/423
LUMBAR Y FORCE (-LB)	261/266	529/523	373/392*
NECK MX TORQ (LB*IN)	588/595	721/725	800/801
HEAD Y ACCEL (MS)	139/141	122/122	118/119
HEAD Z ACCEL (MS)	105/105	97/98	91/92
CHEST Y ACCEL (MS)	85/86	78/79	79/78
LUMBAR Y ACCEL (MS)	76/77	63/65	61/62
NECK Y FORCE (MS)	131/127	120/121	116/115
NECK Z FORCE (MS)	106/105	96/95	91/91
LUMBAR Y FORCE (MS)	72/70	67/61*	59/60
NECK MX TORQ (MS)	136/138	125/126	113/114

\*RAM data deviating more than  $\pm 5\%$  from ADACS data

TABLE 18  
LARGE ADAM ADACS/RAM -Gx DATA  
X-BAND 45° HARNESS

CHANNEL (-Gx)	10G	20G	30G
HEAD X ACCEL (-G)	15.7/15.9	45.4/45.5	72.8/74.6
HEAD Z ACCEL (-G)	4.5/4.6	30.8/31.3	59.3/62.6*
CHEST X ACCEL (-G)	12.8/13.4	36.0/38.0*	42.9/44.6
LUMBAR X ACCEL (-G)	13.5/13.9	27.9/27.5	61.8/66.9*
NECK X FORCE (LB)	153/154	460/434*	697/697
NECK Z FORCE (LE)	55.7/63.7*	254/178*	385/424*
LUMBAR X FORCE (-LB)	193/187	932/910	1485/1445
NECK MY TORQ (LB*IN)	234/225	449/565*	824/829
HEAD X ACCEL (MS)	102/106	88/88	78/80
HEAD Z ACCEL (MS)	96/99	70/71	64/66
CHEST X ACCEL (MS)	80/77	69/70	50/65*
LUMBAR X ACCEL (MS)	78/80	75/58*	49/51
NECK X FORCE (MS)	102/105	87/88	77/80
NECK Z FORCE (MS)	241/237	70/101*	87/66*
LUMBAR X FORCE (MS)	104/104	85/86	76/76
NECK MY TORQ (MS)	95/96	82/85	72/73

\*RAM data deviating more than  $\pm 5\%$  from ADACS data

TABLE 19  
LARGE ADAM ADACS/RAM -Gx DATA  
X-BAND 90° HARNESS

CHANNEL (-Gx)	10G	20G	30G (2)
HEAD X ACCEL (-G)	16.5/16.1	52.1/52.0	79.3/77.5
HEAD Z ACCEL (-G)	6.4/6.0*	—	61.1/54.5*
CHEST X ACCEL (-G)	13.3/13.7	—	51.3/55.7*
LUMBAR X ACCEL (-G)	13.9/13.3	30.3/30.4	44.0/44.0
NECK X FORCE (LB)	164/169	511/510	778/770
NECK Z FORCE (LB)	77/64*	266/292*	462/337*
LUMBAR X FORCE (-LB)	121/109*	1208/1207	2091/2051
NECK MY TORQ (LB*IN)	164/180*	609/626	915/959
HEAD X ACCEL (MS)	105/103	88/89	78/79
HEAD Z ACCEL (MS)	94/95	—	66/68
CHEST X ACCEL (MS)	91/93	—	61/62
LUMBAR X ACCEL (MS)	76/75	58/59	58/60
NECK X FORCE (MS)	111/112	88/89	79/80
NECK Z FORCE (MS)	243/242	75/76	62/90*
LUMBAR X FORCE (MS)	100/101	90/92	78/79
NECK MY TORQ (MS)	110/111	83/85	73/75
CHANNEL (-Gx)	40G (2)	45G	
HEAD X ACCEL (-G)	100/98.8	117/109*	
HEAD Z ACCEL (-G)	103/97.4*	109/97.5*	
CHEST X ACCEL (-G)	63.5/71.4*	71.2/77.8*	
LUMBAR X ACCEL (-G)	96.4/108*	98.4/109*	
NECK X FORCE (LB)	984/956	1169/1087*	
NECK Z FORCE (LB)	—	786/746*	
LUMBAR X FORCE (-LB)	2793/2749	3943/3828	
NECK MY TORQ (LB*IN)	1443/1511	1609/1757*	
HEAD X ACCEL (MS)	74/76	70/70	
HEAD Z ACCEL (MS)	68/76*	72/73	
CHEST X ACCEL (MS)	57/58	52/54	
LUMBAR X ACCEL (MS)	44/45	41/43	
NECK X FORCE (MS)	74/73	70/71	
NECK Z FORCE (MS)	—	72/73	
LUMBAR X FORCE (MS)	74/75	71/71	
NECK MY TORQ (MS)	69/70	65/67	

\*RAM data deviating more than 5% from ADACS data

TABLE 20  
PERCENT LARGE ADAM RAM DATA  
WITHIN 5% OF ADACS DATA

CHANNEL (+Gy)	PEAK MAG	TIME-TO-PEAK
HEAD Y ACCEL	100%	100%
HEAD Z ACCEL	100%	100%
CHEST Y ACCEL	100%	100%
LUMBAR Y ACCEL	100%	83%
NECK Y FORCE	83%	83%
NECK Z FORCE	100%	100%
LUMBAR Y FORCE	50%	67%
NECK MX TORQUE	100%	100%
CHANNEL (-Gx)		
HEAD X ACCEL	88%	100%
HEAD Z ACCEL	29%	86%
CHEST X ACCEL	43%	86%
LUMBAR X ACCEL	63%	88%
NECK X FORCE	75%	100%
NECK Z FORCE	0%	57%
LUMBAR X FORCE	88%	100%
NECK MX TORQUE	63%	100%

TABLE 21  
WILCOXON SIGNED RANK TEST SUMMARIES FOR  
LARGE ADAM RAM VS. ADACS DATA

CHANNEL (+GY)	PEAK MAG	TIME-TO-PEAK
HEAD Y ACCEL	0.0% (NSD)	+0.8% —
HEAD Z ACCEL	-1.5% (.10)	+0.8% (.10)
CHEST Y ACCEL	0.0% (NSD)	+1.2% (NSD)
LUMBAR Y ACCEL	0.0% (NSD)	+1.5% (.10)
NECK Y FORCE	-0.4% (NSD)	-2.4% (NSD)
NECK Z FORCE	+0.6% (NSD)	-0.8% —
LUMBAR Y FORCE	+2.8% (NSD)	-0.5% (NSD)
NECK MX TORQUE	-0.4% (NSD)	+0.8% (.10)
CHANNEL (-Gx)		
HEAD X ACCEL	-1.8% (.10)	+1.3% (.10)
HEAD Z ACCEL	-5.5% (NSD)	+0.3% (.10)
CHEST X ACCEL	+8.9% (.05)	+3.4% (NSD)
LUMBAR X ACCEL	+7.0% (.10)	-0.5% (NSD)
NECK X FORCE	-2.6% (.05)	+1.3% (.05)
NECK Z FORCE	-6.5% (NSD)	-0.7% (NSD)
LUMBAR X FORCE	-2.0% (.05)	+0.7% (.10)
NECK MY TORQUE	+5.8% (.05)	+2.0% (.05)

# LARGE ADAM, +GY

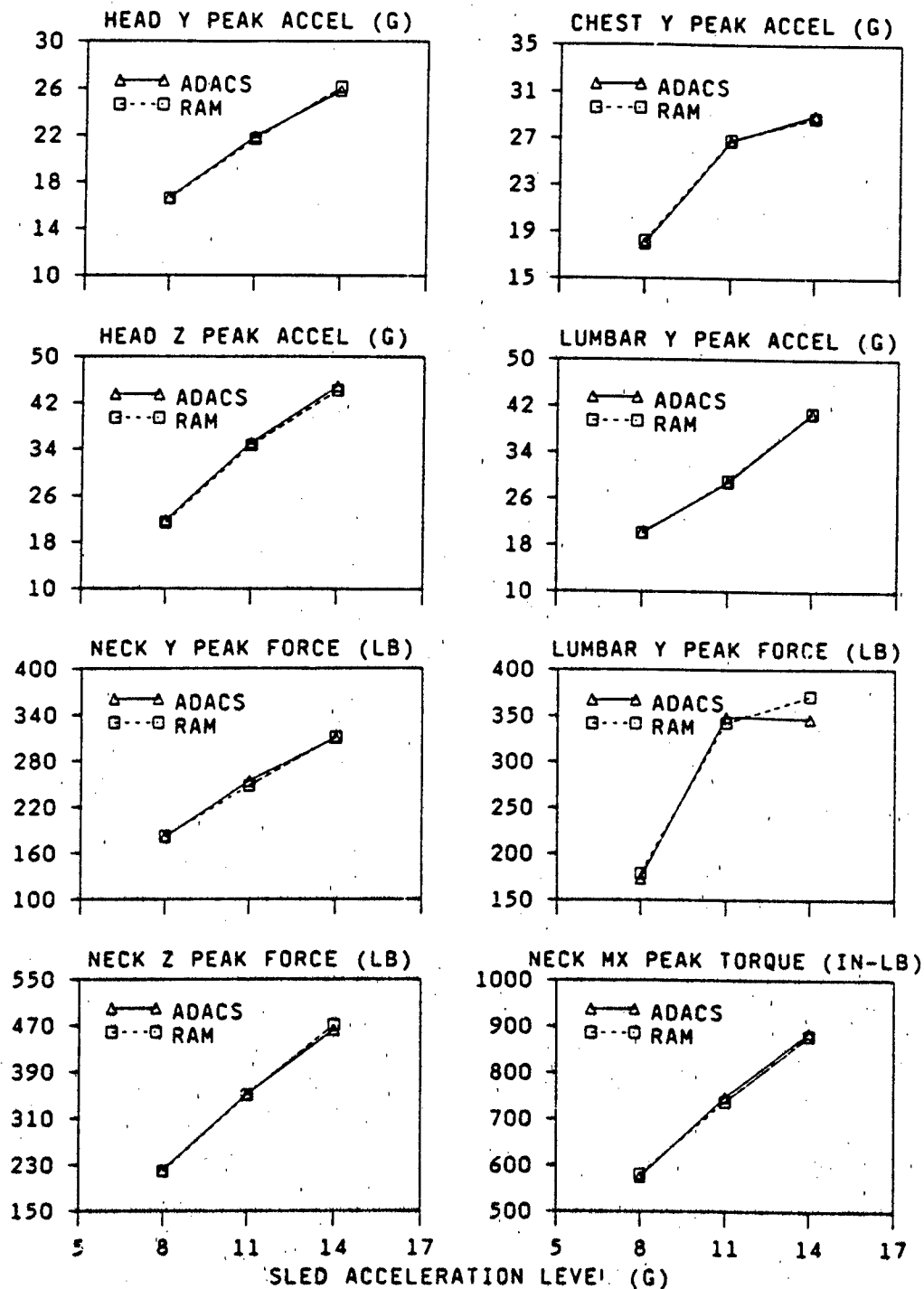


FIGURE 12. LARGE ADAM +Gy DYNAMIC RESPONSES VS. CARRIAGE ACCELERATION



LARGE ADAM, -GX

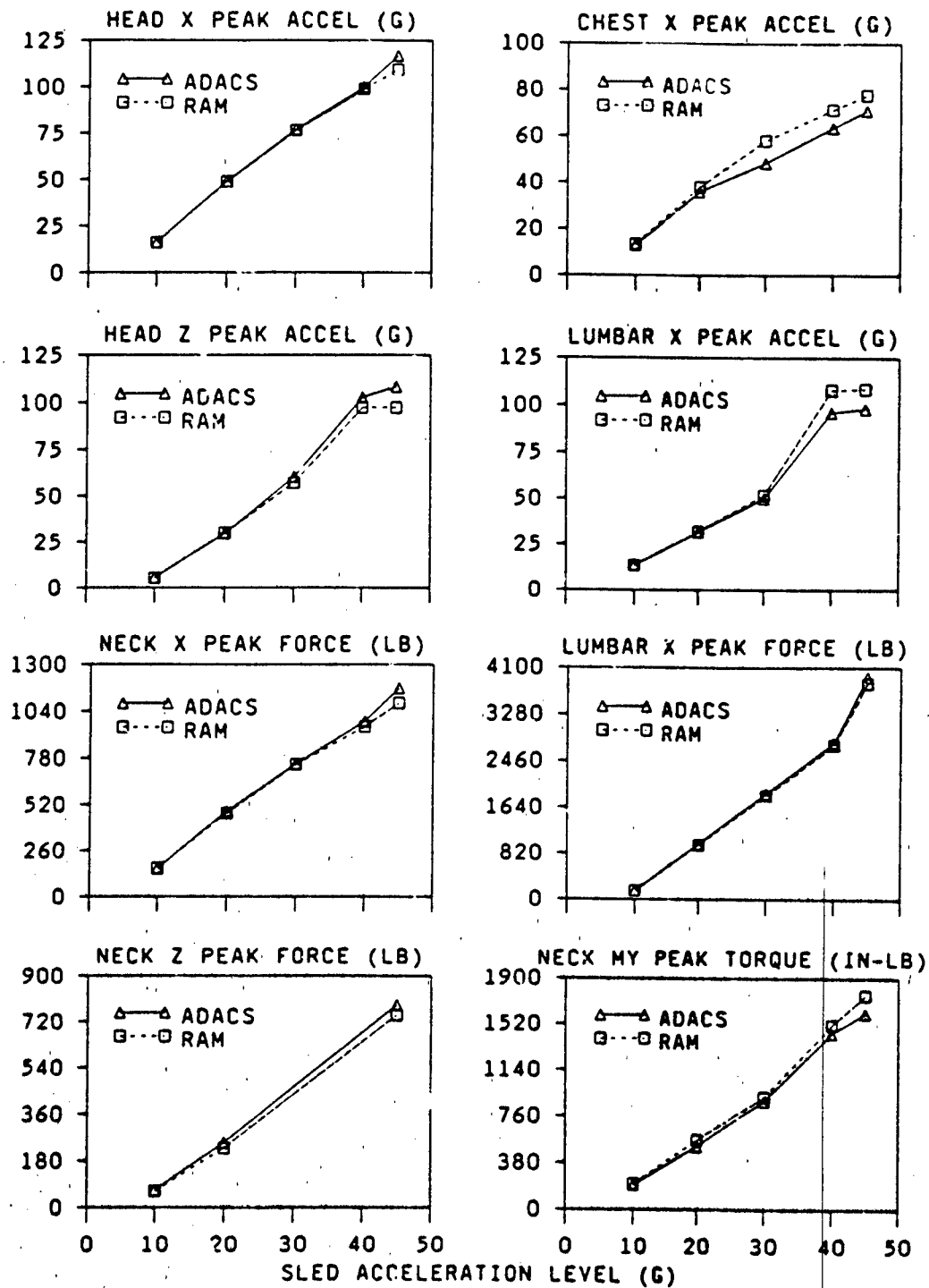


FIGURE 13. LARGE ADAM -GX DYNAMIC RESPONSES VS. CARRIAGE ACCELERATION

### Temperature measurement

Wilcoxon Signed Rank tests were performed to compare the ADAM RAM internal peak temperature measurements with those of the ADACS, and are summarized in Table 22. In the +Gy tests, the RAM mean temperature was significantly lower in both the small ADAM (-21%) and the large ADAM (-22%) than the corresponding ADACS data. In the -Gx tests, however, the RAM temperature was slightly higher than the ADACS in both ADAMs, although the differences were not statistically significant. The large difference in the temperature measurements between the +Gy and the -Gx tests was due to the addition of ADAM voltage offsets into the ADACS calculations prior to the -Gx tests. After the adjustments were made, the temperature differences between the ADAM and the ADACS systems in the -Gx tests were reasonable considering the relatively low resolution (3.9° C / bit) of the ADAM temperature measurement system.

TABLE 22  
WILCOXON SIGNED RANK TEST SUMMARIES FOR ADACS VS  
RAM PEAK TEMPERATURE COMPARISONS ( $\alpha = 0.05$ )

+Gy	ADACS	RAM	% CHANGE
SMALL ADAM	126° C	100° C	-21%
LARGE ADAM	108° C	84.5° C	-22%
-Gx			
SMALL ADAM	77.1° C	80.7° C	NSD
LARGE ADAM	81.8° C	87.8° C	NSD

### Extraneous data

Excessive noise was first observed on several small ADAM channels after the initial small ADAM test. To prevent recurrence of the noise, .01 uf capacitors were installed in the noisy small ADAM channel lines. These were not entirely effective since the noise continued to a lesser extent throughout the small as well as the large ADAM tests. Table 23 lists the ADAM channels with the highest observable noise levels along with the criteria for designating those channels as such. Small ADAM test 3484 was not included since the capacitive filters were not installed until after this test. Note that even with the filters, more noisy channels were present in the small ADAM tests (17) than in the large ADAM tests (8). The noise was not randomly distributed among all the channels in either ADAM but instead tended to recur in the same relatively small number of channels. The occurrence of the noise appeared to be unrelated to impact since it was apt to occur at any time before, during, or after the acceleration impulse. Since the ADACS system, which had its input lines tapped directly from the ADAM sensors, showed little or no noise throughout the tests, defective sensors and/or high amplitude external noise would appear to be unlikely causes. Also unlikely to have contributed to the

noise levels were defects in the electronic signal conditioning, since this network is essentially the same for all channels (the low-level channels as a group, however, do require more amplification than the high-level channels). A more likely cause would be loose, partially broken, or improperly shielded internal wires and faulty connections. Additional ADAM design work may be needed to either eliminate the cause of the noise or increase the effectiveness of the channel filtering.

TABLE 23  
SUMMARY OF DATA NOISE

SMALL ADAM

CHANNEL	NO. OF NOISY DATA
X-LUMBAR ACCEL	3
Y-LUMBAR ACCEL	1
LEFT LOWER LEG TORQUE NEG	2
Y-LUMBAR MOMENT	4
RT STERN ELEV	4
RT HIP SUPINE ABD/ADD	3
TOTAL	17

LARGE ADAM

CHANNEL	NO. OF NOISY DATA
Z-CHEST ACCEL	3
Y-LUMBAR ACCEL	2
Y-CHEST ACCEL	1
X-CHEST ACCEL	1
LEFT LOWER LEG TORQUE NEG	1
TOTAL	8

CRITERIA FOR DESIGNATION OF NOISY DATA

ACCELEROMETER: NOISE LEVEL > 4 G  
LOAD CELL: NOISE LEVEL > 500 LB-IN  
POSITION SENSOR: NOISE LEVEL > 8°

High amplitude spikes were present in much of the ADAM test data, usually occurring after maximum acceleration. The spikes were either single or multiple and most were of negative polarity. Unlike the occurrences of noise, the spikes were present in many different channels (16 in the large ADAM and 7 in the small ADAM). Table 24 summarizes the occurrences of spikes in both ADAMs. Many more spikes occurred in the large ADAM (37) than in the small ADAM (7) and many more were present in the DECOM systems of both ADAMs (38) than in the RAM systems (6). The spikes presented problems in the data analysis. Due to their large amplitude, which was usually larger than the response itself, filtering of the data was required. This involved accessing the response files and eliminating the data during the time of the spike for each affected channel. Also, the scaling of the "quick look" plots was disproportionate to the response amplitude since the entire spike had to be included in the plot. The occurrence of the spikes after maximum acceleration and the fact that 86% occurred in the DECOM as opposed to the RAM system indicates that the

source of the spikes was probably between the DECOM takeoff connection and the whip cable connection or improper shielding in the whip cable.

TABLE 24  
SUMMARY OF DATA SPIKES

SENSOR	SMALL ADAM		LARGE ADAM	
	DECOM	RAM	DECOM	RAM
ACCELEROMETER	2	1	5	0
LOAD CELL	3	0	12	5
POSITION SENSOR	1	0	15	0
TOTAL	6	1	32	5

#### Reliability of ADAM Instrumentation

are summarized in Table 25. For the small ADAM, 4 tests of the tests were considered ADAM failures. They were 11 G in the +Gy tests, and 40 G and 45 G in the -Gx tests. For the large ADAM, 5 out of 18, or 27.8% of the tests were failures. They occurred at -20 G (2), -30 G, and -40G (2). All the failures of both ADAMs were due to electrical instrumentation and data collection systems, identified as hardware related. For further details, see Test Narrative.

TABLE 25  
SUMMARY OF ADAM FAILURES

TEST NO.	ADAM	ACCELERATION LEVEL	PROBLEM	CAUSE
3484	S	+8 Gy	NO RAM DATA	MEMORY BOARD FAILURE
3494	S	+11 Gy	NO RAM/DECOM DATA	DIGITAL I/O BOARD FAILURE
3499	L	-20 Gx	Z-HEAD ACCEL CHANNEL	DEFECTIVE WIRE
3505	L	-20 Gx	X-CHEST ACCEL CHANNEL	DEFECTIVE WIRE
3518	L	-30 Gx	Z-NECK FORCE CHANNEL	DEFECTIVE WIRE
3521	L	-40 Gx	Z-NECK FORCE CHANNEL	DEFECTIVE WIRE
3523	S	-40 Gx	LARGE SPIKE IN DATA	UNDETERMINED
3525	L	-40 Gx	Z-NECK FORCE CHANNEL	DEFECTIVE HEAD/NECK LOAD CELL
3526	S	-45 Gx	NO DECOM DATA	UNDETERMINED

### Hardware

In the small ADAM, circuit board failures occurred during tests in the memory board at +8 Gx and the digital I/O board at +11 Gy. The digital I/O board also failed during a pre-test at -10 Gx. In the large ADAM, a circuit board failure occurred during a pre-test in the CRIB (Crest Interface Board) at -30 Gx.

Three types of transducers were employed in the large and small ADAMs. These were accelerometers, load cells, and position sensors. All three types performed very reliably, with only two recorded instances of failure. These were the large ADAM left sternoclavicular joint extension/retraction position sensor after a -10 Gx test and the large ADAM head/neck z-axis load cell after a -40 Gx test. It should also be noted that in large ADAM tests at -30 Gx and -40 Gx, the V-Lumbar Moment load cell was saturated due to its rated value of + 3000 lb-in being exceeded by more than 10% during the tests.

Most of the problems associated with defective ADAM test data were due to breaks in wires and faulty connections to internal components, especially transducers, in both large and small ADAM. Table 26 gives a summary of the combined +Gy and -Gx locations for faulty wiring and connections. The main sources of these problems were in the wiring and connections to the knee load cells of both ADAMs, the position sensors of both ADAMs, and the accelerometers of the large ADAM.

TABLE 26  
SUMMARY OF FAULTY WIRES/CONNECTIONS

SMALL ADAM		LARGE ADAM	
ACCELEROMETERS	0	ACCELEROMETERS	5
LOAD CELLS, KNEE	12	LOAD CELLS, KNEE	7
LOAD CELLS, OTHER	2	LOAD CELLS, OTHER	2
POSITION SENSORS	6	POSITION SENSORS	9
START SIGNAL WIRE	1	TELEMETRY PORT	1
CPU BOARD INTERCONNECT	1		
TOTAL	22	TOTAL	24

### Data transfer

The transfer of both the RAM and DECOM test data from the ADAM to the DRASS unit was efficient and reliable. No loss of data in any of the tests was shown to have occurred as a result of a malfunction of the DRASS unit. However, DECOM test data was lost in test 3502 due to the DRASS unit being incorrectly set in the "download" position during the test. The DECOM test data was also lost in test 3526 and since no cause was determined, the possibility of a similar DRASS operator error or a DRASS malfunction should

be considered. In one other test, the battery system of the DRASS was discovered to be low prior to the actual data collection, and a slight delay occurred while recharging was performed.

Regarding the transfer of data to the computers, no problems were attributed to either the DRASS to Z-100 or the Z-100 to VAX transfer of the ADAM data.

#### Procedural checks and measurements

ADAM pre and post electrical checks both required several minutes to perform but appeared to be very good indicators of any defective channels. No instances of false channel status were indicated by the hand-held display terminal which was used to perform these checks. However, during the pre electrical check of test 3498, the terminal was observed to have been loading down the "start signal". This was due to the terminal having been left in the incorrect mode after a previous ADAM maintenance was performed.

Lists of ADAM channel sensitivities and polarities were submitted prior to testing and were revised when necessary. In both the +Gy and -Gx tests, some of the polarities of the ADAM channels initially did not match those of the ADACS channels and had to be revised. During the -Gx tests it was discovered that several position channels were showing inverted responses and new sets of polarities were submitted for those channels.

When the initial ADAM channels sensitivities list was compiled, no offset voltages were used in the gain computations. Also, it was determined that the voltage standard was out of calibration at the time of the measurements. Therefore, the initial ADAM sensitivities list resulted in incorrect magnitude response measurements for the entire series of +Gy tests. The sensitivities were revised using the offset voltages and a correct voltage standard, and the +Gy response data was reprocessed.

Due to the large range of sled acceleration levels in the -Gx tests (10 G to 45 G), it was decided to employ increased sensitivities for some channels at lower G levels and decreased sensitivities at higher G levels. The sensitivities of the z-axis accelerometers were not revised as planned and the first 30 G test was completed with the incorrect decreased sensitivities. However, no saturated data were observed. In another instance, it became necessary to revise the sensitivity of the Y-Lumbar Moment channel due to transducer saturation. However, the new sensitivity was not submitted on time and the RAM data had to be reprocessed.

In summary, the procedural methods for determining, revising, and submitting the ADAM channel sensitivities and polarities did not appear to be very efficient. It should be noted, however, that there was often a limited amount of time between ADAM tests which could have contributed to some of the procedural problems.

## Stability of ADAM Instrumentation

### System stability indicators

Although the ADAM channel sensitivities were revised several times for various reasons (see previous section), no accurate data were available for comparison of the sensitivities before and after the two series of tests. Therefore, the exact effect of impact on the channel sensitivities and system gain over both entire series of tests could not be determined.

One indicator of the system stability in the ADAM low-level channels was the difference between the pre-impact RCal-NonRCal values and the post-impact RCal-NonRCal values which was printed out in hex after each test. A change in this value in any channel indicated a change in the system gain during impact for that channel. Table 27 shows that the change in these values exceeded two bits in 3.7% of the small ADAM individual channel tests and 1.7% of the large ADAM tests. The values exceeded three bits in less than 1% of the tests in both ADAMs. It would appear, therefore, that the range of error of the ADAM instrumentation output at the measured RCal levels was  $\pm 3$  bits, or  $\pm 0.12$  volts per test. However, this range does not take into consideration the cumulative change in output over a series of tests.

TABLE 27  
DIFFERENCES BETWEEN PRE- AND POST-IMPACT  
RCAL-NONRCAL DATA

	TOTAL NO. DATA	NO. BITS CHANGE IN CALIBRATION				
		3 BITS	4 BITS	5 BITS	6 BITS	7 BITS
SMALL ADAM	628	17	3	1	1	1
LARGE ADAM	517	6	1	2	0	0

### Repeatability of response

Four pairs of -Gx repeatability tests were run with each test pair having its own set of parameters as to subject, G-level, and harness type. Both tests in each pair were performed consecutively in the test schedule. The percentage of change in peak magnitude (G) and time-to-peak (MS) between identical tests for both small and large ADAM RAM data are shown in tables 28 and 29. No statistical tests could be performed due to the small number of pairs. The results, however, appear to indicate a trend of poorer peak magnitude repeatability with increasing G-level, as indicated by the generally higher percentages in the 30 G test pairs as opposed to the 20 G pairs. The data also appear to indicate better peak magnitude repeatability in the small ADAM than in the large ADAM, with a wide range of percentages observed in both ADAMs. The time-to-peak data showed only small variations in the test pairs, with the exception of the large ADAM Lumbar X Acceleration and Neck Z Force data.

TABLE 28  
SMALL ADAM DYNAMIC RESPONSE REPEATABILITY

CHANNEL (-GX)	20G	30G
HEAD X ACCEL (G)	-2.1%	+15.0%
HEAD Z ACCEL (G)	-23.9%	+11.5%
CHEST X ACCEL (G)	-3.2%	-11.5%
LUMBAR X ACCEL (G)	-2.0%	-21.9%
NECK X FORCE (LB)	-3.3%	+16.2%
NECK Z FORCE (LB)	-6.6%	+18.2%
LUMBAR X FORCE (LB)	+12.5%	+17.1%
NECK MY TORQ (LB-IN)	-6.7%	-6.6%
HEAD X ACCEL (MS)	0.0%	0.0%
HEAD Z ACCEL (MS)	+1.4%	0.0%
CHEST X ACCEL (MS)	-5.6%	-2.0%
LUMBAR X ACCEL (MS)	+3.3%	0.0%
NECK X FORCE (MS)	-2.4%	+0.0%
NECK Z FORCE (MS)	+1.0%	-1.2%
LUMBAR X FORCE (MS)	0.0%	+1.3%
NECK MY TORQ (MS)	-5.3%	0.0%

TABLE 29  
LARGE ADAM DYNAMIC RESPONSE REPEATABILITY

CHANNEL (-GX)	20G	30G
HEAD X ACCEL (G)	-7.0%	-7.3%
HEAD Z ACCEL (G)	+7.6%	-26.5%
CHEST X ACCEL (G)	—	+14.2%
LUMBAR X ACCEL (G)	-37.5%	-42.5%
NECK X FORCE (LB)	-9.3%	-10.5%
NECK Z FORCE (LB)	-21.1%	—
LUMBAR X FORCE (LB)	+12.6%	-10.6%
NECK MY TORQ (LB-IN)	+12.8%	-34.4%
HEAD X ACCEL (MS)	-3.4%	0.0%
HEAD Z ACCEL (MS)	0.0%	1.5%
CHEST X ACCEL (MS)	—	-6.7%
LUMBAR X ACCEL (MS)	-10.3%	+26.1%
NECK X FORCE (MS)	-3.4%	0.0%
NECK Z FORCE (MS)	+29.7%	—
LUMBAR X FORCE (MS)	-5.8%	-3.9%
NECK MY TORQ (MS)	-2.4%	-1.4%



## SUMMARY AND CONCLUSIONS

### Summary

Large and small production ADAMS were subjected to impacts of up to 14 G in the +y axis and 45 G in the -x axis, in a simulated CREST ejection seat. Tests were conducted using both the CREST X-Band 45° and X-Band 90° harnesses.

Data were recorded for sled acceleration, sled velocity, harness anchor loads, manikin internal temperature, head accelerations, chest acceleration, neck forces, lumbar force, and lumbar acceleration.

The test data were used to evaluate ADAMS' structural adequacy, simulation of human dynamic response, instrumentation accuracy, instrumentation reliability, and electronics stability.

### Conclusions

The tests showed the ADAMS to be structurally sound, but prone to circuit board and wiring failures. Heavier gage wire would be appropriate in the joints that see large motions.

Both ADAMS adequately measured the phase and magnitude of the dynamic impact responses over time, but neither ADAM was able to consistently approximate the peak magnitude of the responses to within 5% of the expected values. The low resolution of the ADAM's data conversion system, along with excessive noise in the data, made the dynamic response plots difficult to read and analyze, especially at lower acceleration levels.

The overall simulation of human dynamic response by the ADAMS is very good, though fine tuning of the head and neck might improve the accuracy of the ADAM head accelerations, which were too high relative to the human head accelerations measured in a previous program. Note that these judgments are based on -x axis acceleration conditions, as no data is yet available for human response to +y axis accelerations.

#### REFERENCES

1. Brinkley, J.W. and Schimmel, D.E. Impact Tests of T-46A Personnel Restraint Systems. AAMRL-TR-87-043, 1987.
2. McClave, J.T. and Dietrich II, F.H. Statistics. San Francisco CA: Dellen Publishing Co., and London: Collier Macmillan Publishers, 1985.
3. Shaffer, J.T. The Impulse Accelerator: An Impact Sled Facility for Human Research and Safety Systems Testing. AMRL-TR-76-8, 1976.
4. Systems Research Laboratories. Operation and Maintenance Manual for Advanced Anthropomorphic Manikin. Prepared by SRL for Harry G. Armstrong Aerospace Medical Research Laboratory, 1988.

TEST CONFIGURATION AND  
DATA ACQUISITION SYSTEM FOR THE  
HORIZONTAL IMPACT OF ANTHROPOMORPHIC  
MANIKINS (CREST CHIA)  
TEST PROGRAM  
DURING +Gy AND -Gx ACCELERATIONS

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Prepared by  
Marshall Z. Miller  
and  
Stephen E. Mosher

DynCorp  
Scientific Support Division  
Building 824, Area B  
Wright-Patterson AFB, Ohio 45433

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## INTRODUCTION

This report was prepared by DynCorp for the Harry G. Armstrong Aerospace Medical Research Laboratory (AAMRL/BBP) under Air Force Contract F33615-86-C-0531.

The information provided herein describes the test facility, seat fixture, restraint configurations, seat cushions, test subjects, data acquisition, instrumentation procedures and the test configurations that were used in the Horizontal Impact of Anthropomorphic Manikins (CREST CHIA) Test Program During +Gy And -Gx Accelerations. Forty-four tests were conducted during November and December 1988 on the Horizontal Accelerator test facility.

### 1. TEST FACILITY

The AAMRL Horizontal Accelerator Facility was used for all of the forty-four tests. The Horizontal Accelerator Facility consists of the 24-inch HYGE actuator, the test sled and 240 feet of track. The Horizontal Accelerator is designed to simulate an impact profile by accelerating the test sled down the track.

The energy required to produce the impact acceleration is generated within the actuator cylinder (Figure A-1) by means of differential gas pressures acting upon a thrust piston. This thrust piston is attached to a thrust column assembly which is used to impact the sled. As pressure moves the thrust assembly, the sled is accelerated from an initial stationary position to a predetermined peak acceleration level and is then allowed to decelerate by coasting or by brake application. Various acceleration profiles may be obtained by changing the differential pressures, the travel length of the thrust assembly and the metering structure on the thrust piston. The sled glides along the track rails on twelve glide pads. The sled braking system consists of caliper brakes which grip the track rails when activated by onboard compressed nitrogen gas. The track rails are one inch thick and the total track length is 240 feet. For this test program, the Bendix Square Wave Pin (pin number 2) was used.

### 2. SEAT FIXTURE

The experimental seat fixture was the 40 G seat mounted on the Horizontal Accelerator Sled. The seat fixture was modified to represent the CREST seat in an F-16 cockpit. For the -Gx configuration tests, a 17 degree wedge was used placing the seat back angle 30 degrees aft of vertical and the seat pan 30 degrees above horizontal. Figure A-2 illustrates the -Gx configuration seat fixture.

For the +Gy configuration tests, the seat back angle was 13 degrees aft of vertical and the seat pan was 13 degrees above horizontal. Figure A-3 illustrates the +Gy configuration seat fixture.

The subject was secured in the seat with lower-torso restraint straps and shoulder straps. These straps were preloaded as required in the test plan.

### 3. RESTRAINT CONFIGURATIONS

Two restraint configurations were tested. The two restraint configurations consisted of variations of the X-Band harness. The configurations differed only in the attachment locations of the lower-torso restraint straps; 90 degrees (designated X-Band-90) and 45 degrees (designated X-Band-45) relative to the z axis.

The X-Band-45 harness is illustrated in Figure A-3 with the manikin secured in the +Gy seat fixture. The X-Band-90 harness is illustrated in Figure A-4 with the manikin secured in the -Gx seat fixture.

### 4. SEAT CUSHIONS

The CREST cushion was used during this test program. The CREST cushion is a one-inch thick Confor<sup>TM</sup> C45FR foam cushion coated with Selastic-E RTV. The CREST cushion was used on both the seat pan and seat back as illustrated in Figure A-2.

An extra cushion was used for the -Gx configuration when testing the Small ADAM manikin. This extra cushion was attached to the CREST seat back cushion with velcro and was used to obtain the shoulder preloads as required in the test plan. This extra cushion uses four, one-half inch thick Confor<sup>TM</sup> C47 foam layers, separated by NOMEX fabric. This extra seat cushion, installed on the -Gx Configuration seat fixture is illustrated in Figure A-5.

### 5. TEST SUBJECTS

Two manikins, the large and small Advanced Dynamic Anthropomorphic Manikins (ADAMs), were used during this test program.

### 6. INSTRUMENTATION

The electronic data collected during this test program is described in Sections 6.1 and 6.2. Section 6.1 discusses accelerometers while Section 6.2 discusses load transducers. Section 6.3 discusses the calibration procedures that were used. The measurement instrumentation used in this

test program are listed in Tables A-1a through A-1d for the +Gy acceleration configuration and Tables A-2a through A-2d for the -Gx acceleration configuration. These figures designate the manufacturer, type, serial number, sensitivity and other pertinent data on each transducer used. Table A-3 lists the manufacturer's typical transducer specifications.

Accelerometers and load transducers were chosen to provide the optimum resolution over the expected test load range. Full scale data ranges were chosen to provide the expected full scale range plus 50% to assure the capture of peak signals. All transducer bridges were balanced for zero output prior to the start of each test. The accelerometers were adjusted for the effect of gravity using computer processing software. The component of a 1 G vector in line with the force of gravity that lies along the accelerometer axis was added to each accelerometer.

The accelerometer and load transducer coordinate systems are shown in Figure A-6. The seat coordinate system is right-handed with the z axis parallel to the seat back and positive in the direction of the subject's head. The x axis is perpendicular to the z axis and positive eyes forward from the subject. The y axis is perpendicular to the x and z axes according to the right hand rule. The origin of the seat coordinate system is designated as the seat reference point (SRP). The SRP is at the midpoint of the line segment formed by the intersection of the seat pan and seat back. All vector components (for accelerations, angular accelerations, forces, moments, etc.) are positive when the vector component (x, y and z) is in the direction of the positive axis.

The linear accelerometers were wired to provide a positive output voltage when the acceleration experienced by the accelerometer is applied in the +x, +y and +z directions, as shown in Figure A-6.

The angular Ry accelerometers were wired to provide a positive output voltage when the angular acceleration experienced by the angular accelerometer is in the +y direction according to the right hand rule, as shown in Figure A-6.

The load cells and strain gages were wired to provide a positive output voltage when the force exerted by the load cell on the subject is applied in the +x, +y or +z directions, as shown in Figure A-6.

The Mx torque transducer was wired to provide a positive output voltage when the torque experienced by the transducer is applied in the +x direction according to the right hand rule as shown in Figure A-6.

Sled velocity was measured using Globe Industries tachometer Model 22A672-2. The rotor of the tachometer was attached to an aluminum wheel with a rubber O-ring around its circumference to assure good rail contact. The wheel contacted the track rail and rotated as the sled moved, producing an output voltage proportional to the velocity.



## 6.1 Accelerometers

This section describes the accelerometer instrumentation as required in the AAMRL/BBP test plan.

The external chest accelerometer package consisted of three Endevco Model 7264-200 linear accelerometers, mounted to a 1/2 x 1/2 x 1/2 inch aluminum block, for accelerations in the x, y and z directions. An Endevco Model 7302A angular (Ry) accelerometer was mounted on a bracket adjacent to the triaxial chest block. The accelerometer packages were inserted into a steel protection shield to which a length of Velcro fastener strap was attached. The package was placed over the subject's sternum at the level of the xyphoid and was held there by fastening the Velcro strap around the subject's chest. Figure A-7 illustrates the chest accelerometer package.

The Horizontal Accelerator ram acceleration was measured using an Endevco Model 2262A-200 accelerometer. The accelerometer was mounted near the front surface of the ram, off the sled, and used as a backup to the primary sled mounted accelerometer.

Sled accelerations were measured using three Endevco accelerometers: one Model 2262A-200 for accelerations in the x direction (accelerations in the y direction for the +Gy configuration), one Model 2264-200 for accelerations in the y direction (accelerations in the x direction for the +Gy configuration) and one Model 2264-200 for accelerations in the z direction. Two separate aluminum blocks were used to mount the three accelerometers, sled x on one block (sled y for the +Gy configuration) and sled y (sled x for the +Gy configuration) and z on the other block. Both blocks and their respective accelerometers were mounted on the underside center of the sled.

Seat back accelerations were measured using three Endevco Model 2264-200 linear accelerometers for accelerations in the x, y and z directions. The three linear accelerometers were attached to a 1 x 1 x 3/4 inch acrylic block and were mounted behind the seat back.

For Large and Small ADAM manikin +Gy configuration tests, head y and z acceleration, chest y acceleration, and Lumbar y acceleration were each measured using Entran EGA-125F-100D linear accelerometers. For Large and Small ADAM manikin -Gx configuration tests, head x and z acceleration, chest x acceleration, and lumbar x acceleration were each measured using Entran EGA-125F-100D linear accelerometers. These accelerometers were internally mounted in the manikins.

## 6.2 Load Transducers

This section describes the load transducer instrumentation as required in the AAMRL/BBP test plan.

The load transducer locations and dimensions are shown in Figures A-8 and A-9 for the -Gx configuration and the +Gy configuration respectively. All dimensions are referenced to the Seat Reference Point (SRP). The

Seat Reference Point is located at the intersection of the seat pan center line (x axis) and the seat back (z axis) center line.

Shoulder/anchor forces were measured using two GM-3D-SW, one GM/DYN 3D-SW and three AAMRL/DYN 3D-SW triaxial load cells, each capable of measuring forces in the x, y and z directions. The parameters measured are indicated below:

- Left shoulder x, y and z force
- Right shoulder x, y and z force

- X-Band-90 and X-Band-45 harnesses:

- Left horizontal x, y and z anchor force
- Right horizontal x, y and z anchor force
- Left vertical x, y and z anchor force
- Right vertical x, y and z anchor force

Shoulder roller y and z forces and the shoulder roller torque (Mx) were measured using a strain gaged T-Bar (shoulder harness roller bracket). This specially instrumented T-Bar was fabricated by DynCorp using Micro Measurement Model EA-06-1258Z-350 strain gages.

The left and right shoulder anchor load cells are illustrated by Figure A-10. Also shown is the T-Bar (shoulder harness roller bracket) and the roller assembly. The strain gages instrumented on the T-Bar can be seen in Figure A-11.

The left horizontal and vertical anchor load cells are illustrated by Figure A-12 while Figure A-13 shows the right horizontal and vertical anchor load cells. Both Figures A-12 and A-13 represent the +Gy test configuration and the X-Band-45 harness attachments.

Figure A-14 shows the right horizontal and vertical anchor load cells for the -Gx test configuration and the X-Band-90 harness attachments.

For Large and Small ADAM manikin +Gy configuration tests, head/neck y and z forces and Mx torque were measured using a Denton Model 1716 load cell while lumbar y force was measured using a Denton Model 1914 load cell. For Large and Small ADAM manikin -Gx configuration tests, head/neck x and z forces and My torque were measured using a Denton Model 1716 load cell while lumbar x force was measured using a Denton Model 1914 load cell. These load cells were internally mounted in the manikins.

### 6.3 Calibration

Calibrations were performed before and after testing to confirm the accuracy and functional characteristics of the transducers. Pre-program and post-program calibrations are given in Tables A-4a through A-4g.

The calibration of the accelerometers was performed by DynCorp using the comparison method (Ensor, 1970). A laboratory standard accelerometer, calibrated on a yearly basis by Endevco with standards traceable to the

National Bureau of Standards, and a test accelerometer were mounted on a shaker table. The frequency response and phase shift of the test accelerometer were determined by driving the shaker table with a random noise generator and analyzing the outputs of the accelerometers with a PDP 11/15 computer and 1923 Time Data Unit using Fourier analysis. The natural frequency and the damping factor of the test accelerometer were determined, recorded and compared to previous calibration data for that test accelerometer. Sensitivities were calculated at 40 G and 100 Hertz. The sensitivity of the test accelerometer was determined by comparing its output to the output of the standard accelerometer.

The angular accelerometers were calibrated by DynCorp by comparing their output to the output of a linear standard accelerometer. The angular accelerometer is mounted parallel to the axis of rotation of a Honeywell low inertia D. C. motor. The standard accelerometer is mounted perpendicular to the axis of rotation at a radius of one inch to measure the tangential acceleration. The D. C. motor motion is driven at a constant sinusoidal angular acceleration of 100 Hertz and the sensitivity is calculated by comparing the rms output voltages of the angular and linear accelerometers.

The load cells and strain gages were calibrated by DynCorp. These transducers were calibrated to a laboratory standard load cell in a special test fixture. The sensitivity and linearity of each test load cell were obtained by comparing the output of the test load cell to the output of the laboratory standard under identical loading conditions. The laboratory standard load cell, in turn, is calibrated by PMEL on a periodic basis.

The velocity wheel is calibrated periodically by DynCorp by rotating the wheel at approximately 2000, 4000, and 6000 revolutions per minute (RPM) and recording both the output voltage and the RPM.

## 7. DATA ACQUISITION

Data acquisition was controlled by a comparator on the Master Instrumentation Control Unit in the Instrumentation Station. The test was initiated when the comparator countdown clock reached zero. The comparator was set to start data collection at a preselected time.

A reference mark pulse was generated to mark the ADACS electronic data at a preselected time after test initiation to place the reference mark close to the impact. At the same time, the reference mark pulse triggered a strobe light to mark the test photogrammetric data. The reference mark time was used as the start time for data processing of the electronic and photogrammetric data.

Prior to each test and prior to placing the subject in the seat, data were recorded to establish a zero reference for all data transducers. These data were stored separately from the test data and were used in the processing of data.

### 7.1 Automatic Data Acquisition and Control System (ADACS)

Installation of the ADACS instrumentation for the +Gy and -Gx test configurations are shown in Figures A-15 and A-16 respectively. The three major components of the ADACS system are the power conditioner, signal conditioners and the encoder. A block diagram of the ADACS is shown in Figure A-17. The signal conditioners contain forty-eight amplifiers with programmable gain and filtering.

Bridge excitation for load cells and accelerometers was 10 VDC. Bridge completion and balance resistors were added as required to each module input connector.

The forty-eight module output data signals were digitized and encoded into forty-eight 11-bit digital words. Two additional 11-bit synchronization (sync) words were added to the data frame making a fifty word capability.

Three synchronization pulse trains (bit sync, word sync and frame sync) were added to the data frame and sent to the computer via a junction box data cable.

The PDP 11/34 minicomputer received serial data from the ADACS. The serial data coming from the sled are converted to parallel data in the data formatter. The data formatter inputs data by direct memory access (DMA) into the computer memory via a buffered data channel where data are temporarily stored on disk. Data are later transferred to the VAX 11/750 and output to magnetic tape for permanent storage.

The interrelationships among the data acquisition and storage equipment are shown in Figure A-18.

Test data could be reviewed immediately after each test by using the "quick look" SCAN routine. SCAN was used to produce a plot of the data stored on any channel as a function of time. The routine determined the minimum and maximum values of any data plot. It was also used to calculate the rise time, pulse duration, sled acceleration and create a disk file containing significant test parameters.

### 7.2 Photogrammetric Data Acquisition

Two onboard high-speed LOCAM cameras, operating at 500 frames per second, were used to produce the photogrammetric data for the +Gy test configuration. The front camera was a LOCAM Model 50-0002 (S/N 374) and the oblique camera was a LOCAM Model 50-0002 (S/N 387). The front camera used a 10mm lens (S/N 665054) and the oblique camera used a 12.5mm lens (S/N 12728). The two camera locations are shown in Figure A-3.

Two onboard high-speed LOCAM cameras, operating at 500 frames per second, were used to produce the photogrammetric data for the -Gx configuration tests 3498 through 3523. The side camera was a LOCAM Model 50-0002 (S/N 374) and the oblique camera was a LOCAM Model 50-0002 (S/N 387).

Both cameras used an 9mm lens (S/N 69519 and 72019). For -Gx configuration tests 3524 through 3527 the side camera used was a Photosonics Model 16mm 1B-100 (S/N 906); the oblique camera used was a Photosonics Model 16mm 1B-100 (S/N 673). Both cameras used an 8 mm lens. The two camera locations are shown in Figure A-22.

Motion of the subjects' cheek, mouth, upper chest, lower chest, shoulder, elbow and knee were quantified by tracking the motion of subject-mounted fiducials. Reference fiducials were placed on the test fixture. The size of the fiducials used was a .75" diameter black circle on a 1.25" diameter white target. The locations of the fiducials generally followed the guidelines provided in "Film Analysis Guides for Dynamic Studies of Test Subjects, Recommended Practice" (SAE J138, March 1980). Figures A-19 and A-20 identifies the fiducial target locations for the +Gy test configuration while Figures A-21 and A-22 identifies the fiducial target locations for the -Gx test configuration.

All cameras were automatically started at a preset time in the test sequence by a signal from the camera and lighting control station.

The photogrammetric data were time correlated in each test. Immediately prior to impact, a reference mark signal triggered the flash unit to mark the camera film frame. At that time, a 100 PPS signal activated the camera light emitting diode (LED) driver which activated the camera LED, producing a time mark at the film edge. This reference mark was then used to correlate the photogrammetric data with the electronically measured data.

The photogrammetric data will be processed as required on the Automatic Film Reader (AFR) system, shown in the block diagram in Figure A-23. The fiducial tracking routine is initiated via the Data General terminal. The tracking routine is booted from a floppy disk into the Nova 3/12 memory. The system is capable of tracking fiducials manually or automatically. The Nova 3/12 outputs an x-y film coordinate position to magnetic tape for each fiducial being tracked. Data are transferred from magnetic tape to the DEC PDP 11/34 disk file and then transferred to the DEC VAX 11/750 disk file for processing.

An Instant Analytical Replay (INSTAR) video system was also used to provide coverage of each test. This video recorder and display unit is capable of recording high-speed motion at a rate of 120 frames per second. Immediate replay of the impact is possible in real time or in slow motion.

## 8. PROCESSING PROGRAMS

Test data for the CREST CHIA Study was collected using two separate data collection systems. The facility instrumentation and the standard subject instrumentation were monitored using the ADACS data collection system. During tests where the ADAM dummy was the subject, additional test data was collected using the ADAM internal data collection system.

The executable images for the ADACS processing programs are located in directory PROCESS of the VAX 11/750 and the test data is assumed to be stored in directory DATA1. All plots and the test summary sheet are output to the LNO3 laser printer. The ADACS test summary file is output to directory PROCESS.

The executable images for the ADAM processing programs are located in directory PROCESS of the VAX 11/750. The plots and the test summary sheet are output to the Tektronix hardcopy unit. The ADAM test summary file is output to directory PROCESS.

#### 8.1 ADACS Program Operation

The two Fortran programs that process the ADACS test data for the +Gy configuration of the CREST CHIA Study are named CREST CHIAHACØA and CHIAHACØB. The DCL file which controls the execution of these programs is named CHIAHACGY. The character string 'CHIAHAC' identifies the study, 'Ø' is the revision number and the last character determines the program order of execution.

CHIAHACØA accepts user input and creates a temporary DCL file which controls the sequential batch processing of a specified number of tests. CHIAHACØA requests the user to enter the total number of tests to be processed and the test number of each test. Directory DATA1 is assumed to contain a zero reference file named '<test no>Z.HAC', a test data file named '<test no>D.HAC' and a sensitivity file named '<test no>S.HAC'.

CHIAHACØA requests the user to enter the total number of tests to be processed and the test number for each test. The default test parameters are retrieved from the header block of the test data file and displayed as a menu on the screen. The user may specify new values for any of the displayed test parameters. The test parameters include the subject ID, weight, age, height and sitting height. Additional parameters include the cell type, nominal G level, subject type (manikin or human) and belt preload status (computed or not computed). If the belt preloads were computed, then the shoulder, anchor and roller preloads are also displayed.

CHIAHACØB does the actual data processing of the test data. CHIAHACØB generates time histories for the sled, seat and chest linear accelerations, the sled velocity and the chest Ry angular acceleration. Time histories for the shoulder forces, anchor forces, roller forces and roller torque are also generated. In addition, CHIAHACØB computes time histories for the ADAM internal temperature, head y and z, chest y and lumbar y accelerations, the neck y and z and lumbar y forces, and the neck x axis torque. The impact rise time, duration and velocity change are computed and stored in the test base file.

The output of CHIAHACØB consists of a test summary file, summary sheet and plots. The summary file contains the preimpact levels and extrema for the individual channels and the derived quantities. The summary sheet displays the extrema in a more readable format. The time histories

of the parameters are plotted to a disk file and sent to the laser printer.

The two Fortran programs that process the ADACS test data for the -Gx configuration of the CREST CHIA Study are named CHIAHAC1A and CHIAHAC1B.

The DCL file which controls the execution of these programs is named CHIAHACGX. Program CHIAHAC1A accepts user input and creates a DCL file which controls the processing of all of the specified tests. Program CHIAHAC1B performs the actual data processing.

All of the ADACS channels that were analyzed for the +Gy configuration of the CREST CHIA Study were also analyzed for the -Gx configuration. However, the ADAM channels analyzed for the -Gx configuration were the ADAM internal temperature, head x and z accelerations, chest x and lumbar x accelerations, neck x and z forces, lumbar x force and neck y axis torque. Due to the change in seat orientation and the higher G levels, the -Gx configuration of the CREST CHIA Study required different plotting scales than the +Gy configuration.

## 8.2 ADAM Processing Programs

The two Fortran programs that process the ADAM test data are named ADAM\_DATA and ADAM\_DECOM. ADAM\_DATA is an interactive program which converts data collected in internal ram memory into engineering units and plots or lists the resulting time histories. ADAM\_DECOM is an interactive program which converts data transmitted real time during the test into engineering units and plots or lists the results. The Fortran library ADAM\_PLOTS provides subroutine support for both programs.

ADAM\_DATA requests the user to enter the ADAM test data filename, the test number and the reference mark voltage. The reference mark is used to correlate the ADAM data with the ADACS data. The user also specifies whether the output is to be plotted or listed and whether the results are to be stored in a test summary file. The channel numbers, descriptions, sensitivities, offsets and plotting parameters are read in from the channel specification file. Time histories of the channels are plotted or listed for 600 ms starting from the reference mark time. Time zero corresponds to the start of impact.

ADAM\_DECOM requests the user to enter both the test data filename (internal ram) and the test decom filename (transmitted). This is necessary because the information required to determine the position of the channels in the frame is not transmitted and must be determined from the internal ram data. ADAM\_DECOM also displays the number of frames containing bad sync patterns and requests the user to indicate whether to continue processing the corrupted data. Aside from these differences, ADAM\_DECOM is functionally equivalent to ADAM\_DATA.

Flowcharts of the ADAM processing programs are not included because they are designed to analyze any ADAM test data and are not specific to this study.

DIGITAL INSTRUMENTATION REQUIREMENTS												
CREST HORIZONTAL IMPACT OF ANTIDROMIC												
PROGRAM MARKING 401 (CH15) TESTS												
DATE 02 NOV 88												
THRU 17 NOV 88												
FACILITY HORIZONTAL ACCELERATOR												
RUN 3484												
THRU 3497												
DATA CHANNEL	DATA POINT	INSTR TYPE	SERIAL NUMBER	EXCITE V	FILTER SERIES	AMP DATE	SAMPLE RATE	FULL SCALE SENS.	FILTER #	REDUCE ZERO RANGE	BRIDGE BALANCE COMP RESISTORS	SPECIAL NOTATIONS
1	SLID 7	ENDVECO 2262A-200	PM 31	10.00	60	10	1K	49.90	120	2.5	-	
2	SLID 8	ENDVECO 2264-200	BQ 47	10.00	60	50	1K	15.90	120	2.5	-	1.5K
3	SLID 9	ENDVECO 226A-200	BM 61	10.00	60	50	1K	17.20	120	2.5	160K +1M QRD.	1.5K
4	LEFT SHOULDER 10-SW 1 FORCE	CM	152	10.00	60	201	1K	1965LB	120	2.5	14K +1M QRD.	-
5	LEFT SHOULDER 10-SW 2 FORCE	CM	151	10.00	60	402	1K	1152LB	120	2.5	-	-
6	LEFT SHOULDER 10-SW 3 FORCE	CM	154	10.00	60	402	1K	114.7LB	120	2.5	-	-
7	RIGHT SHOULDER 10-SW 1 FORCE	CM/DTH	202	10.00	60	201	1K	1977LB	120	2.5	90K -1M QRD.	-
8	RIGHT SHOULDER 10-SW 2 FORCE	CM/DTH	205	10.00	60	402	1K	1169LB	120	2.5	25K +1M QRD.	-
9	RIGHT SHOULDER 10-SW 3 FORCE	CM/DTH	203	10.00	60	402	1K	1269LB	120	2.5	43K +1M QRD.	-
10	LEFT MORITZ 10-SW 1 FORCE	AAHBL/DTH	234	10.00	60	201	1K	1563LB	120	2.5	-	-
11	LEFT MORITZ 10-SW 2 FORCE	AAHBL/DTH	237	10.00	60	201	1K	1740LB	120	2.5	45K +1M QRD.	-
12	LEFT MORITZ 10-SW 3 FORCE	AAHBL/DTH	235	10.00	60	201	1K	1803LB	120	2.5	17K +1M QRD.	-
13	RIGHT MORITZ 10-SW 1 FORCE	AAHBL/DTH	243	10.00	60	201	1K	1563LB	120	2.5	32K +1M QRD.	-
14	RIGHT MORITZ 10-SW 2 FORCE	AAHBL/DTH	247	10.00	60	201	1K	1759LB	120	2.5	-	-

WEIGHTS:		SIGNALS FURNISHED TO ADAM:		ADAMS SUPPORT PLATE	
SHOULDER LOAD CELL CLEVIS		0-3" P-P @ 15 Hz SINE WAVE		SMALL ADAM	
145° AND 90° CLEVIS WITH BOLT		0-3" P-P @ 15 Hz SINE WAVE		SMALL ADAM	
190° CLEVIS WITH EXTENSION		0-3" P-P @ 15 Hz SINE WAVE		SMALL ADAM	
ADAMS SUPPORT PLATE		0-3" P-P @ 15 Hz SINE WAVE		SMALL ADAM	
SMALL ADAM		0-3" P-P @ 15 Hz SINE WAVE		SMALL ADAM	
SMALL ADAM		0-3" P-P @ 15 Hz SINE WAVE		SMALL ADAM	
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SMALL ADAM		0-3" P-P @ 15 Hz SINE WAVE		SMALL ADAM	
SMALL ADAM		0-3" P-P @ 15 Hz SINE WAVE		SMALL ADAM	
SMALL ADAM		0-3" P-P @ 15 Hz SINE WAVE		SMALL ADAM	
SMALL ADAM		0-3" P-P @ 15 Hz SINE WAVE		SMALL ADAM	
SMALL ADAM		0-3" P-P @ 15 Hz SINE WAVE		SMALL ADAM	
SMALL ADAM					

MASTED STATION COMPENSATIONS:  
 COMPUTER START: -6 SECONDS  
 5 VDC ADAM START: -2 SECONDS

SIGNALS FURNISHED TO ADAM:  
 6V P-P @ 75 Hz SINE WAVE  
 0-3V P-P @ 100 Hz SQUARE WAVE

WEIGHTS:  
 SHOULDER LOAD CELL CLAVIS  
 1.5LB  
 1.5LB AND 90° CLAVIS WITH NOUR  
 1.0LB  
 1.0LB CLAVIS WITH EXTENSION  
 10.0LB  
 ADAMS SUPPORT PLATE  
 15.3LB  
 SMALL ADAM  
 1.5LB

LARGE ADAM  
 07 FOOT PLATE PLUS HARDWARE 5.5LB  
 SEAT BACK PLUS SEAT PAN 17LB  
 SEAT FRAME (INCLUDING BOLTS) 23LB  
 CAMERA 5.5LB  
 OPTICUM CAMERA MOUNT 15LB

TABLE A-1a: INSTRUMENTATION REQUIREMENTS (+GY ACCELERATION CONFIGURATION)



DIGITAL INSTRUMENTATION REQUIREMENTS													
CHEST HORIZONTAL IMPACT OF SEISMIC TESTS													
PROGRAM MARKING: 40 (CHIA) TESTS													
FACILITY: HORIZONTAL ACCELERATOR													
DATE 02 NOV88													
THRU 11 NOV 88													
SUM 3484													
THRU 3497													
DATA CHANNEL	INSTR. TYPE	DATA POINT	INSTR. TYPE	REDUCER SENS	EXCITER V	FILTER BANDWIDTH	AMP GAIN	SAMPLE RATE	FULL SCALE SENS.	FILTER BANDWIDTH	REDUCER SENS	BRIDGE BALANCE RESISTORS	SPECIAL NOTATIONS
15	RIGHT HORIZ. FORCE	201	15	10.00	15	15	10	1K	168 LB	120	2.5	19K	
16	LEFT VERTICAL FORCE	211	16	10.00	16	16	10	1K	1217 LB	120	2.5	19K	
17	LEFT VERTICAL FORCE	211	17	10.00	17	17	11	1K	1272 LB	120	2.5	19K	
18	LEFT VERTICAL FORCE	212	18	10.00	18	18	12	1K	2032 LB	120	2.5	19K	
19	RIGHT VERTICAL FORCE	231	19	10.00	19	19	11	1K	1805 LB	120	2.5	19K	
20	RIGHT VERTICAL FORCE	231	20	10.00	20	20	13	1K	1725 LB	120	2.5	19K	
21	RIGHT VERTICAL FORCE	232	21	10.00	21	21	10	1K	3218 LB	120	2.5	19K	
22	SHOULDER ROLLERS	301	22	10.00	22	22	16	1K	1777 LB	120	2.5	19K	
23	SHOULDER ROLLERS	302	23	10.00	23	23	5	1K	911 LB	120	2.5	19K	
24	SHOULDER ROLLERS	303	24	10.00	24	24	1	1K	2734 LB	120	2.5	19K	
25	VELOCITY	226573-2	25	10.00	25	25	1	1K	12477/SEC	60	0.0	19K	
26	SEAT BACK ACCEL.	226573-2	26	10.00	26	26	1	1K	1000	120	2.5	19K	
27	SEAT BACK ACCEL.	226573-2	27	10.00	27	27	2	1K	17.70	120	2.5	19K	
28	SEAT BACK ACCEL.	226573-2	28	10.00	28	28	11	1K	33.00	120	2.5	19K	

PAGE 2 OF 1

TABLE A-1b: INSTRUMENTATION REQUIREMENTS (+Gy ACCELERATION CONFIGURATION)

DIGITAL INSTRUMENTATION REQUIREMENTS									
CUSTOM HORIZONTAL IMPACT OF AUTOMORPHIC									
PROGRAM DATES 02 NOV 89 THRU 11 NOV 89									
FACILITY HORIZONTAL ACCELERATION									
DATA CHANNEL	DATA POINT	ZOOCHE HPC & TYPE	SERIAL NUMBER	EDUCHE RMS	RECTIFY V	FILTER Hertz	AMP Gain	SAMPLE RATE	FULL SCALE SENS.
29	SEATBELT ACCEL.	EDUCHE 2264-200	8137	2.754 mv/g	10.00	60	25	1K	36.30
30	*INTERNAL TEMP.			10.0 mv/C	-	60	1	1K	250°C
31	*HEAD & ACCEL.	EDUCHE 204-125 V14-14	10464	2.53 mv/g	-	60	5	1K	197.60
32	*HEAD & ACCEL.	EDUCHE 204-125 V24-34	10464	2.44 mv/g	-	60	5	1K	204.90
33	*CHST & ACCEL.	EDUCHE 204-125 V7-7	21464	2.46 mv/g	-	60	5	1K	203.30
34	*CHST & ACCEL.	EDUCHE 204-125 V7-7	21464	3.219 mv/g	10.00	60	5	1K	155.30
35	*CHST & ACCEL.	EDUCHE 204-125 V7-7	21464	3.256 mv/g	10.00	60	10	1K	76.80
36	*CHST & ACCEL.	EDUCHE 204-125 V7-7	21464	3.018 mv/g	10.00	60	10	1K	83.14
37	REFERENCE MARK			1.0 VOLTS	-	1000	2.5	1K	2.5 VOLTS
38	*CHST ANGULAR V	EDUCHE 1302A	AB15	6.54 uv/RAD/ SEC	10.00	60	100	1K	3023 RAD/SEC2
39	*HEAD/ BECK & FORCE	EDUCHE 1716	0127	6.43 uv/LB	-	60	402	1K	1404LB
40	*HEAD/ BECK & FORCE	EDUCHE 1716	0127	9.45 uv/LB	-	60	201	1K	1316LB
41	*LIMBAR Y FORCE	EDUCHE 1915	040	6.30 uv/LB	-	60	201	1K	1974LB
42	*LIMBAR Y ACCEL.	EDUCHE 204-125 V18-18	10464	2.58 mv/g	-	60	10	1K	96.90

\* SMALL ADAM TRANSDUCERS

TABLE A-1c: INSTRUMENTATION REQUIREMENTS (+GY ACCELERATION CONFIGURATION)

DIGITAL INSTRUMENTATION REQUIREMENTS										DYNCORP				
PROGRAM														
FACILITY HORIZONTAL ACCELERATOR														
DATA CHANNEL	DATA POINT	INSTRUMENT TYPE	SERIAL NUMBER	EXCITER RMS	EXCITER V	FILTER BANDWIDTH	AMP GAIN	SAMPLE RATE	FULL SCALE SENS.	FILTER Hz	EXCITER ZERO RANGE	BRIDGE BALANCE RESISTORS	BRIDGE COMP RESISTORS	SPECIAL NOTATIONS
43	BECK IN TORQUE	1716	0127	6.28 mv/lb	-	60	100	1K	3081 18-lb	120	2.5 45.0	-	-	
44	100 Hz. SQ. WAVE	-	-	1.0 VOLT	-	1000	1	1K	3 V P-P	2000	2.5 45.0	-	-	TEST 3487 AND SUBSEQUENT 3 V P-P ROUTED THROUGH AMP 43 TO
45	75 Hz. SINE WAVE	-	-	1.0 VOLT	-	1000	1	1K	3 V P-P	2000	2.5 45.0	-	-	TEST 3490 AND SUBSEQUENT 3 V P-P ROUTED THROUGH AMP 47 TO
47	2.5 VOLT SINE	-	-	1.0 VOLT	-	180	1	1K	2.5 VOLTS	360	2.5 45.0	-	-	ATTEN. 0.5 TO ADAPT
48	10 VOLT SINE	-	-	1.0 VOLT	-	180	1	1K	2.5 VOLTS	360	2.5 45.0	-	-	
LARGE ADAM														
31	HEAD & ACCEL.	EXTRAL EGA-125P -1000	12767- V11-11	2.18 mv/g	-		5		201.60					
32	HEAD & ACCEL.	EXTRAL EGA-125P -1000	12768- V9-9	2.12 mv/g	-		5		181.80					
33	CHEST & ACCEL.	EXTRAL EGA-125P -1000	18464- V9-9	2.13 mv/g	-		5		181.20					
39	HEAD/BECK & FORCE	DEXTON 1716	0128	4.53 mv/lb	-		402		1373LB					
40	HEAD/BECK & FORCE	DEXTON 1716	0128	7.90 mv/lb	-		201	5	1574LB					
41	LINEAR & FORCE	DEXTON 1914	041	6.30 mv/lb	-		201	6	1974LB					
42	LINEAR & ACCEL.	EXTRAL EGA-125P -1000	18464- V20-20	2.30 mv/g	-		10		108.70					
43	BECK IN TORQUE	DEXTON 1716	0128	6.40 mv/lb	-		100	22	3906 18-lb					
* SMALL ADAM														

PAGE 1 OF 1

TABLE A-1d: INSTRUMENTATION REQUIREMENTS (+Gy ACCELERATION CONFIGURATION)

DIGITAL INSTRUMENTATION REQUIREMENTS										DYNCORP									
CREST HORIZONTAL IMPACT OF AUTOMORPHIC																			
PROGRAM																			
FACILITY HORIZONTAL ACCELERATOR																			
DATE 28 JUL 88										THRU 22 DEC 88									
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DIGITAL INSTRUMENTATION REQUIREMENTS										DYNACORP				
CREST HORIZONTAL IMPACT OF ANTROPOMORPHIC														
BUILDING -4X (CHIA) TESTS														
FACILITY HORIZONTAL ACCELERATOR														
PROGRAM	DATE	THRU	DATE	THRU	DATE	THRU	DATE	THRU	DATE	THRU	DATE	THRU	DATE	THRU
28 NOV 89	22 DEC 88													
28 NOV 89	22 DEC 88													
DATA CHANNEL	DATA POINT	INDEX	SERIAL NUMBER	INDEX	INDEX	INDEX	INDEX	INDEX	INDEX	INDEX	INDEX	INDEX	INDEX	INDEX
15	RIGHT HORIZ. FORCE	24K	24K	10.00	60	100	100	1K	1	3343LB	120	2.5	45.0	10K
16	LEFT HORIZ. FORCE	21K	21K	10.00	60	201	201	1K	1	2434LB	120	2.5	45.0	10K
17	LEFT VERTICAL FORCE	21K	21K	10.00	60	100	100	1K	1	1272LB	120	2.5	45.0	10K
18	RIGHT VERTICAL FORCE	21K	21K	10.00	60	100	100	1K	1	4085LB	120	2.5	45.0	10K
19	LEFT VERTICAL FORCE	21K	21K	10.00	60	100	100	1K	1	3628LB	120	2.5	45.0	10K
20	RIGHT VERTICAL FORCE	21K	21K	10.00	60	201	201	1K	1	1725LB	120	2.5	45.0	10K
21	LEFT VERTICAL FORCE	21K	21K	10.00	60	100	100	1K	1	3218LB	120	2.5	45.0	10K
22	RIGHT VERTICAL FORCE	21K	21K	10.00	60	201	201	1K	1	1777LB	120	2.5	45.0	10K
23	SHOULDER ROLLERS	30K	30K	10.00	60	100	100	1K	1	3713LB	120	2.5	45.0	10K
24	SHOULDER ROLLERS	30K	30K	10.00	60	201	201	1K	1	2734	120	2.5	45.0	10K
25	VELOCITY	2	2	10.00	60	100	100	1K	1	124	60	0.0	45.0	10K
26	SEAT BACK ACCEL.	266A-200	266A-200	10.00	60	100	100	1K	1	1000	120	2.5	45.0	10K
27	SEAT BACK ACCEL.	266A-200	266A-200	10.00	60	100	100	1K	1	88.70	120	2.5	45.0	10K
28	SEAT BACK ACCEL.	266A-200	266A-200	10.00	60	100	100	1K	1	33.86	120	2.5	45.0	10K

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TABLE A-2b: INSTRUMENTATION REQUIREMENTS (-Gx ACCELERATION CONFIGURATION)

DIGITAL INSTRUMENTATION REQUIREMENTS													
CHEST HORIZONTAL IMPACT OF ANTHROPOMORPHIC													
PROGRAM MARKS FOR INITIAL TESTS													
DATE 28 NOV 88													
THRU 22 DEC 88													
FACILITY HORIZONTAL ACCELERATION													
RUN 308													
THRU 1527													
DATA CHANNEL	DATA POINT	IONCHN	SERIAL NUMBER	EXCITE V	FILTER HZ	AMP	SAMPLE RATE	FULL SCALE SENS.	FILTER HZ	EXCITE ZERO RANGE	BRIDGE BALANCE RESISTORS	BRIDGE COMP RESISTORS	SPECIAL NOTATIONS
29	SEAT BACK & ACCEL.	ENDVCO 2264-200	BM17	10.00	60	25	1K	36.30	120	2.5	110K	1.5K	
30	*INTERNAL TEMP.			-	60	1	1K	250°C	120	0.0	-	-	- INFO QMD.; REF. TO QMD. - 1 WIRE ONLY
31	*HEAD & ACCEL.	LEPTAH BGA-125F 11A-1A -1000		2.53	60	5	1K	197.60	120	2.5	-	-	
32	*HEAD & ACCEL.	LEPTAH BGA-125F 11A-1A -1000		2.52	60	5	1K	1980	120	2.5	-	-	
33	*CHEST & ACCEL.	LEPTAH BGA-125F 11A-1A -1000		2.41	60	10	1K	103.70	120	2.5	-	-	
34	*CHEST & ACCEL.	ENDVCO 7264-200	BM76M	3.219	60	5	1K	155.30	120	2.5	-	1.5K	
35	*CHEST & ACCEL.	ENDVCO 7264-200	BM81M	3.256	60	10	1K	76.80	120	2.5	-	1.5K	
36	*CHEST & ACCEL.	ENDVCO 7264-200	BM87M	3.010	60	5	1K	1660	120	2.5	-	1.5K	
37	REFERENCE MARK			1.0	1000	2.5	1K	2.5 VOLTS	2000	5.0	-	-	
38	*CHEST ANGULAR	ENDVCO 7302A	AB15	6.54	60	25	1K	15290 RAD/SEC <sup>2</sup>	120	2.5	260K	-	
39	*HEAD/NECK & FORCE	DEPTOM 1716	0127	4.43	60	102	1K	1ACALB	120	2.5	-	-	
40	*HEAD/NECK & FORCE	DEPTOM 1716	0127	7.65	60	201	1K	1626LB	120	2.5	-	-	
41	*JAWBAR & FORCE	DACTON 1914	040	6.30	60	50	1K	7937LB	120	2.5	-	-	
42	*JAWBAR & ACCEL.	LEPTAH BGA-125F 11A-1A -1000	21461-83-3	2.53	60	10	1K	98.80	120	2.5	-	-	

TABLE A-2c: INSTRUMENTATION REQUIREMENTS (-6x ACCELERATION CONFIGURATION)

# DYNACORP

## DIGITAL INSTRUMENTATION REQUIREMENTS

CHEST HORIZONTAL IMPACT OF ASTROPHORPHIC DATE 28 NOV 88 THRU 22 DEC 88

PROGRAM MATHIES - Gx (CHAL TESTS)

FACILITY HORIZONTAL ACCELERATOR RUN 1588 THRU 1521

DATA CHANNEL	DATA POINT	EXCIT. SRC & TYPE	SERIAL NUMBER	EXCITER V	FILTER HZ	AMP GAIN	SAMPLE RATE	FULL SCALE SENS.	FILTER HZ	EXCITER ZERO RANGE	BRIDGE BALANCE RESISTORS	BRIDGE COMP RESISTORS	SPECIAL NOTATIONS
43	BECK W TORQUE	DEFTON 1716	0127	6.44 wv/ 18-LB	60	100	1K	3002 18-LB	120	2.5 5.0	-	-	
44	100 HZ SQUARE WAVE	-	-	1.0 VOLT	1000	1	1K	3 V P-P	2000	2.5 5.0	-	-	3 V P-P ROUTED THROUGH AMP 46 TO ADACS
45	75 HZ SINE WAVE	-	-	1.0 VOLT	1000	1	1K	3 V P-P	2000	2.5 5.0	-	-	6 V P-P ROUTED THROUGH AMP 47 TO .5 ATTENUATOR AND OUT TO ADACS
47	2.5 VOLT BIAS	-	-	1.0 VOLT	180	1	1K	2.5 VOLTS	360	2.5 5.0	-	-	
48	10 VOLT EXC.	-	-	1.0 VOLT	180	1	1K	2.5 VOLTS	360	2.5 5.0	-	-	
LARGE ADAM													
31	HEAD & ACCEL.	EXTRAS BCA-125P -1000	12767- V11-11	2.40 wv/g	5	5	14	201.60			-	-	
32	HEAD & ACCEL.	EXTRAS BCA-125P -1000	12767- V4-A	2.40 wv/g	5	5	34	201.60			-	-	
33	CHEST & ACCEL.	EXTRAS BCA-125P -1000	15664- E19-19	2.59 wv/g	10	10	20	96.50			-	-	
39	HEAD/BECK FORCE	DEFTON 1716	0128	4.43 wv/LB	201	201	9	2808LB			-	-	TESTS 3198-3526 GAIN @ 402, P.B. 1373 LB, 8288, 6.55 wv/LB
40	HEAD/BECK FORCE	DEFTON 1716	0128	7.65 wv/LB	201	201	6	1633LB			-	-	TESTS 3198-3526 8288, @ 7.80 wv/LB, P.B. 1595 LB
43	LINEAR & FORCE	DEFTON 1916	041	6.20 wv/LB	50	50	2	8065LB			-	-	
45	LINEAR & ACCEL.	EXTRAS BCA-125P -1000	18664- V6-6	2.50 wv/g	10	10	12	1000			-	-	
43	BECK W TORQUE	DEFTON 1716	0128	6.44 wv/ 18-LB	100	100	22	3002 18-LB			-	-	TESTS 3198-3526 8288, @ 6.40 wv/LB, P.B. 3906 18-LB

© SMALL ADAM

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TABLE A-2d: INSTRUMENTATION REQUIREMENTS (-Gx ACCELERATION CONFIGURATION)

MANUFACTURER	MODEL	RANGE	SENSITIVITY (mV)	RESONANCE FREQ (Hz)	FREQUENCY RESPONSE (Hz.)	EXCITATION (Volt)	2 ARM or 4 ARM	ADDITIONAL NOTES
Endevco	2262A-200	± 200 G	2.5/G	7000	0-2000	10	4 arm	Linear accelerometer .7 damping ratio
Endevco	2264-100	± 200 G	2.5/G	4700	0-1200	10	2 arm	Linear accelerometer
Endevco	7264-200	± 200 G	2.5/G	6000	0-1200	10	2 arm	Linear accelerometer, 1000 G overrange
Endevco	7302A	± 50,000 Rad/Sec <sup>2</sup>	.055 /Rad/Sec <sup>2</sup>	2500	1-600	10	4 arm	Angular accelerometer, X10 overrange
Entran	EGA-125F- 1000	± 100 G	2.5/G	1500	0-800	15	4 arm	Linear accelerometer 500 G overrange .7 damping ratio
Denton	1716	± 3000 LB	.0033/LB	N/A	N/A	10	4 arm	6 axis load cell; 15 V max exc.
Denton	1914	± 3,000 LB	.0017/LB	N/A	N/A	10	4 arm	6 axis load cell; 15 V max exc.

TABLE A-3: TYPICAL TRANSDUCER SPECIFICATIONS



# **DYNACORP PROGRAM CALIBRATION LOG**

CREST HORIZONTAL IMPACT OF AMPHIPHILIC  
PROGRAM MAKING - Gy AND -Gx (CHIA) TESTS  
DATES: 02 NOV 88 - 22 DEC 88  
FACILITY HORIZONTAL ACCELERATOR  
RUN NUMBERS: 3484 - 3527

DATA POINT	TRANSDUCER MFG. & MODEL	SERIAL NUMBER	PRE-CAL		POST-CAL		XCHANGE	NOTES
			DATE	SENS	DATE	SENS		
SLED y	ENDEVCO 2262A-200	FR31	27OCT88	5.013 mv/G	06JAN89	5.030	+3	
SLED x	ENDEVCO 2264-200	BQ47	27OCT88	3.146 mv/G	06JAN89	3.156 mv/G	+3	
SLED z	ENDEVCO 2264-200	BN61	27OCT88	2.902 mv/G	06JAN89	2.895 mv/G	--2	
LEFT SHOULDER x FORCE	GM 3D-SW	15Z	25OCT88	6.33 uv/LB	05JAN89	6.36 uv/LB	+5	
LEFT SHOULDER y FORCE	GM 3D-SW	15Y	25OCT88	5.40 uv/LB	05JAN89	5.40 uv/LB	0	
LEFT SHOULDER z FORCE	GM 3D-SW	15X	25OCT88	5.42 uv/LB	05JAN89	5.43 uv/LB	+2	
RIGHT SHOULDER x FORCE	GM/DYN 3D-SW	20Z	25OCT88	6.29 uv/LB	05JAN89	6.35 uv/LB	+1.0	
RIGHT SHOULDER y FORCE	GM/DYN 3D-SW	20Y	25OCT88	5.32 uv/LB	05JAN89	5.37 uv/LB	+9	
RIGHT SHOULDER z FORCE	GM/DYN 3D-SW	20X	25OCT88	4.90 uv/LB	05JAN89	4.94 uv/LB	+8	
LEFT HORIZ. x FORCE	GM/DYN 3D-SW	23Z	25OCT88	7.96 uv/LB	04JAN89	7.91 uv/LB	--6	

TABLE A-4a: TRANSDUCER PRE- AND POST-CALIBRATION (PAGE 1 OF 7)

# **DYNCORP PROGRAM CALIBRATION LOG**

CREST HORIZONTAL IMPACT OF ANTHROPOMORPHIC  
PROGRAM MANIKINS +Gx AND -Gx (CHIA) TESTS  
FACILITY HORIZONTAL ACCELERATOR

DATES: 02 NOV 88 - 22 DEC 88

RUN NUMBERS: 3484 - 3527

DATA POINT	TRANSDUCER MFG. & MODEL	SERIAL NUMBER	PRE-CAL		POST-CAL		XCHANGE	NOTES
			DATE	SENS uv/LB	DATE	SENS uv/LB		
LEFT HORIZ. y FORCE	AMRL/DYN 3D-SW	23Y	25OCT88	7.15 uv/LB	04JAN89	7.15 uv/LB	0	
LEFT HORIZ. z FORCE	AMRL/DYN 3D-SW	23X	25OCT88	6.90 uv/LB	04JAN89	6.92 uv/LB	+3	
RIGHT HORIZ. x FORCE	AMRL/DYN 3D-SW	24Z	25OCT88	7.96 uv/LB	05JAN89	7.88 uv/LB	-1.0	
RIGHT HORIZ. y FORCE	AMRL/DYN 3D-SW	24Y	25OCT88	7.07 uv/LB	05JAN89	7.06 uv/LB	-1.1	
RIGHT HORIZ. z FORCE	AMRL/DYN 3D-SW	24X	25OCT88	7.39 uv/LB	05JAN89	7.40 uv/LB	+1.1	
LEFT VERTICAL x FORCE	GM 3D-SW	21X	26OCT88	5.11 uv/LB	04JAN89	5.13 uv/LB	+4	
LEFT VERTICAL y FORCE	GM 3D-SW	21Y	26OCT88	4.89 uv/LB	04JAN89	4.87 uv/LB	-4	
LEFT VERTICAL z FORCE	GM 3D-SW	21Z	26OCT88	6.12 uv/LB	04JAN89	6.18 uv/LB	+1.0	
RIGHT VERTICAL x FORCE	AMRL/DYN 3D-SW	25X	26OCT88	6.89 uv/LB	06JAN89	6.94 uv/LB	+7	
RIGHT VERTICAL y FORCE	AMRL/DYN 3D-SW	25Y	26OCT88	7.21 uv/LB	06JAN89	7.27 uv/LB	+8	

TABLE A-4b: TRANSDUCER PRE- AND POST-CALIBRATION (PAGE 2 OF 7)

# **DYNCORP PROGRAM CALIBRATION LOG**

CREST HORIZONTAL IMPACT OF ANTHROPOMORPHIC

**PROGRAM** MANIKINS +GY AND -GX (CHIA) TESTS **DATES:** 02 NOV 88 - 22 DEC 88

**FACILITY** HORIZONTAL ACCELERATOR

**RUN NUMBERS:** 3484 - 3527

DATA POINT	TRANSDUCER MFG. & MODEL	SERIAL NUMBER	PRE-CAL		POST-CAL		XCHANGE	NOTES
			DATE	SENS	DATE	SENS		
RIGHT VERTICAL z FORCE	AMRL/DYN 3D-SW	25Z	26OCT88	7.77 uv/LB	06JAN89	7.80 uv/LB	+4	
SHOULDER ROLLERS y	AMRL/DYN EA-06-125BZ-350	30Y	24OCT88	7.00 uv/LB	04JAN89	7.15 uv/LB	+2.1	
SHOULDER ROLLERS z	AMRL/DYN EA-06-125BZ-350	30Z	24OCT88	6.68 uv/LB	04JAN89	6.87 uv/LB	+2.8	
SHOULDER ROLLERS Mx	AMRL/DYN EA-06-125BZ-350	30Mx	24OCT88	4.55 uv/ in-LB	04JAN89	4.54 uv/ in-LB	-2	
VELOCITY	GLOBE 22A672-2	2	05JAN88	.04034 V/F/S	-	-	-	CALIBRATED PERIODI- CALLY BY DYNCORP PERSONNEL. NO POST- CAL REQUIRED.
RAM ACCELERATION	ENDEVCO 2262A-200	HMT5	27APR88	3.339 mv/G	06JAN89	3.328 mv/G	-3	
SEAT BACK x ACCELERATION	ENDEVCO 2264-200	BN07	27OCT88	2.817 mv/G	05JAN89	2.815 mv/G	-1	
SEAT BACK y ACCELERATION	ENDEVCO 2264-200	BN95	27OCT88	2.962 mv/G	05JAN89	2.967 mv/G	+1	
SEAT BACK z ACCELERATION	ENDEVCO 2264-200	BN17	27OCT88	2.754 mv/G	05JAN89	2.772 mv/G	+6	

TABLE A-4c: TRANSDUCER PRE- AND POST-CALIBRATION (PAGE 3 OF 7)

CREST HORIZONTAL IMPACT OF ANTHROPOMORPHIC  
PROGRAM MANKINS \*GY AND -GX (CHIA) TESTS DATES: 02 NOV 88 - 22 DEC 88  
FACILITY HORIZONTAL ACCELERATOR RUN NUMBERS: 3484 - 3527

TABLE A-4d: TRANSDUCER PRE- AND POST-CALIBRATION (PAGE 4 OF 7)

# **DYNACORP PROGRAM CALIBRATION LOG**

CREST HORIZONTAL IMPACT OF ANTHROPOMORPHIC  
PROGRAM MANIKIN - Gy AND -Gx (CHIA) TESTS DATES: 02 NOV 88 - 22 DEC 88  
FACILITY HORIZONTAL ACCELERATOR RUN NUMBERS: 3484 - 3527

DATA POINT	TRANSDUCER MFG. & MODEL	SERIAL NUMBER	PRE-CAL		POST-CAL		XCHANGE	NOTES
			DATE	SENS	DATE	SENS		
HEAD/NECK z FORCE	DENTON 1716	0127		4.43 uv/LB				
HEAD/NECK x FORCE	DENTON 1716	0127		7.65 uv/LB				
LUMBAR x FORCE	DENTON 1914	040		6.30 uv/LB				
LUMBAR x ACCELERATION	ENTRAN EGA-125F-100D	2146 X-E3-3		2.53 mv/G				
NECK MY TORQUE	DENTON 1716	0127		6.44 uv/ in-LB				
HEAD z ACCELERATION	ENTRAN EGA-125F-100D	1846W- V14-14		2.53 mv/G				
HEAD x ACCELERATION	ENTRAN EGA-125F-100D	1846W- V15-15		2.52 mv/G				ALL TRANSDUCERS ON THIS PAGE WERE LOCATED ON THE SMALL ADAM. PRE- AND POST- CALIBRATIONS ARE CONTRACTOR SRL'S RESPONSIBILITY.
CHEST x ACCELERATION	ENTRAN EGA-125F-100D	1846W- V7-7		2.41 mv/G				
HEAD y ACCELERATION	ENTRAN EGA-125F-100D	1846W- V24-24		2.44 mv/G				
CHEST y ACCELERATION	ENTRAN EGA-125F-100D	2146X- E7-7		2.46 mv/G				

TABLE A-4e: TRANSDUCER PRE- AND POST-CALIBRATION (PAGE 5 OF 7)

# **DYNACORP PROGRAM CALIBRATION LOG**

CREST HORIZONTAL IMPACT OF ANTHROPOMORPHIC  
**PROGRAM** MANIKINS +Gy AND -Gx (CHIA) TESTS  
**FACILITY** HORIZONTAL ACCELERATOR

**DATES:** 02 NOV 88 - 22 DEC 88  
**RUN NUMBERS:** 3484 - 3527

DATA POINT	TRANSDUCER MFG. & MODEL	SERIAL NUMBER	PRE-CAL		POST-CAL		XCHANGE	NOTES
			DATE	SENS	DATE	SENS		
*HEAD/NECK y FORCE	DENTON 1716	0127		9.45 uv/LB				*ALL DATA POINTS ARE SMALL ADAM
*LUMBAR y FORCE	DENTON 1914	040		6.30 uv/LB				
*LUMBAR y ACCELERATION	ENTRAN EGA-125F-100D	18W6W- V18-18		2.58 mv/G				
**HEAD z ACCELERATION	ENTRAN EGA-125F-100D	12T6T- V11-11		2.48 mv/G				**ALL DATA POINTS ARE LARGE ADAM
**HEAD y ACCELERATION	ENTRAN EGA-125F-100D	12T6T- V9-9		2.72 mv/G				
**CHEST y ACCELERATION	ENTRAN EGA-125F-100D	18W6W- V9-9		2.73 mv/G				
**HEAD/NECK z FORCE	DENTON 1716	0128		4.53 uv/LB				ALL TRANSDUCERS ON THIS PAGE WERE LOCATED ON ADAM
**HEAD/NECK y FORCE	DENTON 1716	0128		7.90 uv/LB				MANIKINS. PRE- AND POST-CALIBRATIONS ARE CONTRACTOR SRL'S RESPONSIBILITY.
**LUMBAR y y FORCE	DENTON 1914	041		6.30 uv/LB				

**TABLE A-4f: TRANSDUCER PRE- AND POST-CALIBRATION (PAGE 6 OF 7)**

# **DYNACORP PROGRAM CALIBRATION LOG**

CREST HORIZONTAL IMPACT OF ANTHROPOMORPHIC

**PROGRAM MANIKINS +Gx AND -Gx (CHIA) TESTS**

**DATES: 02 NOV 88 - 22 DEC 88**

**FACILITY HORIZONTAL ACCELERATOR**

**RUN NUMBERS: 3484 - 3527**

DATA POINT	TRANSDUCER MFG. & MODEL	SERIAL NUMBER	PRE-CAL		POST-CAL		XCHANGE	NOTES
			DATE	SENS	DATE	SENS		
**LUMBAR Y ACCELERATION	ENTRAN EGA-125F-100D	18W6W- V20-20		2.30 mv/G				
**HEAD x ACCELERATION	ENTRAN EGA-125F-100D	12T6T- V4-4		2.48 mv/G				
**CHEST x ACCELERATION	ENTRAN EGA-125F-100D	15W6W- E19-19		2.59 mv/G				
**HEAD/NECK x FORCE	DENTON 1716	0128		7.65 uv/LB				
**LUMBAR x FORCE	DENTON 1914	041		6.20 uv/LB				
**LUMBAR x ACCELERATION	ENTRAN EGA-125F-100D	18W6W- V6-6		2.50 mv/G				
**NECK My TORQUE	DENTON 1716	0128		6.44 uv/ 10-LB				
								ALL TRANSDUCERS ON THIS PAGE WERE LOCATED ON THE LARGE ADAM. PRE- AND POST- CALIBRATIONS ARE CONTRACTOR SRL'S RESPONSIBILITY.

TABLE A-4g: TRANSDUCER PRE- AND POST-CALIBRATION (PAGE 7 OF 7)

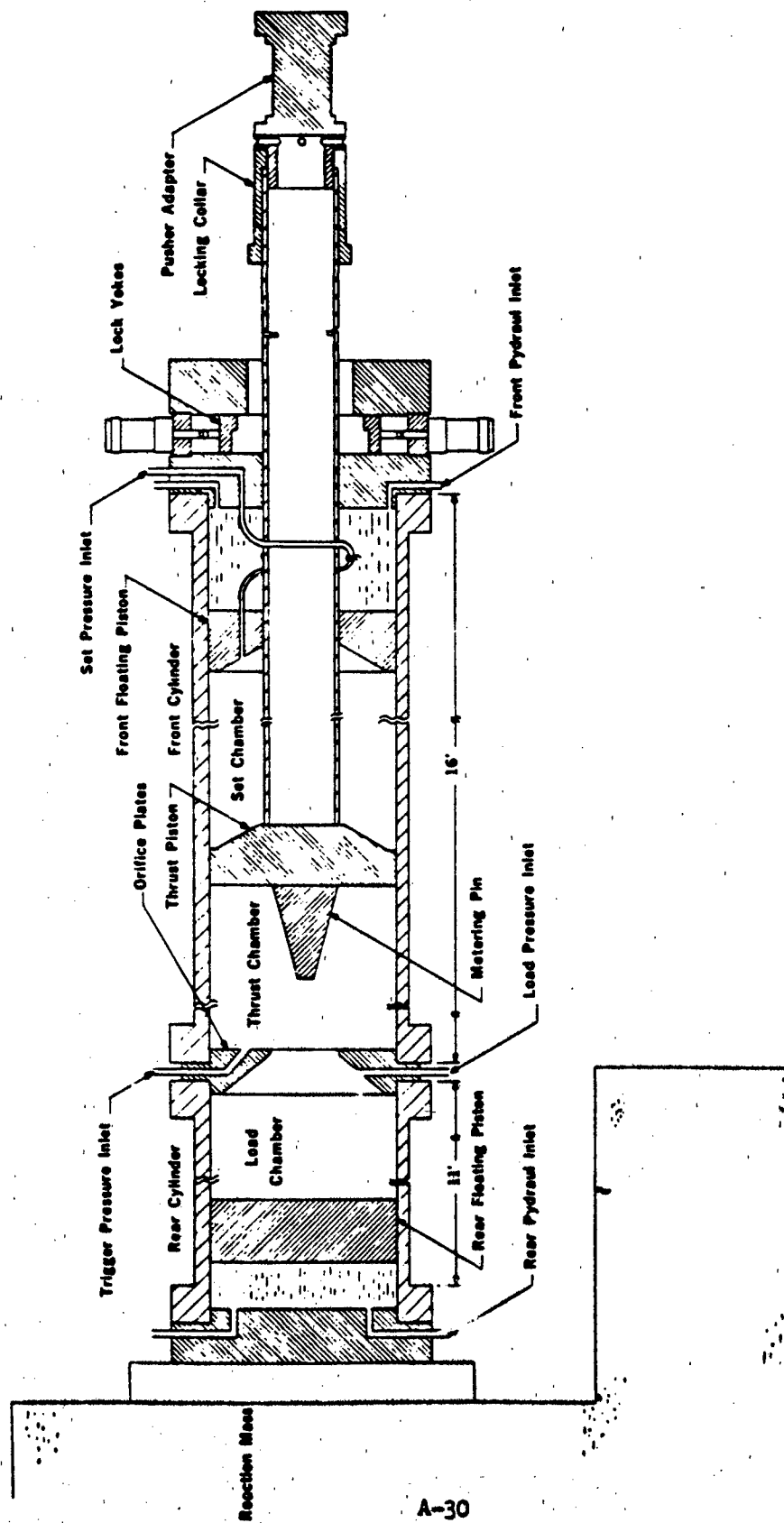


FIGURE A-1: HORIZONTAL ACCELERATOR ACTUATOR





FIGURE A-2: -6x CONFIGURATION SEAT FIXTURE

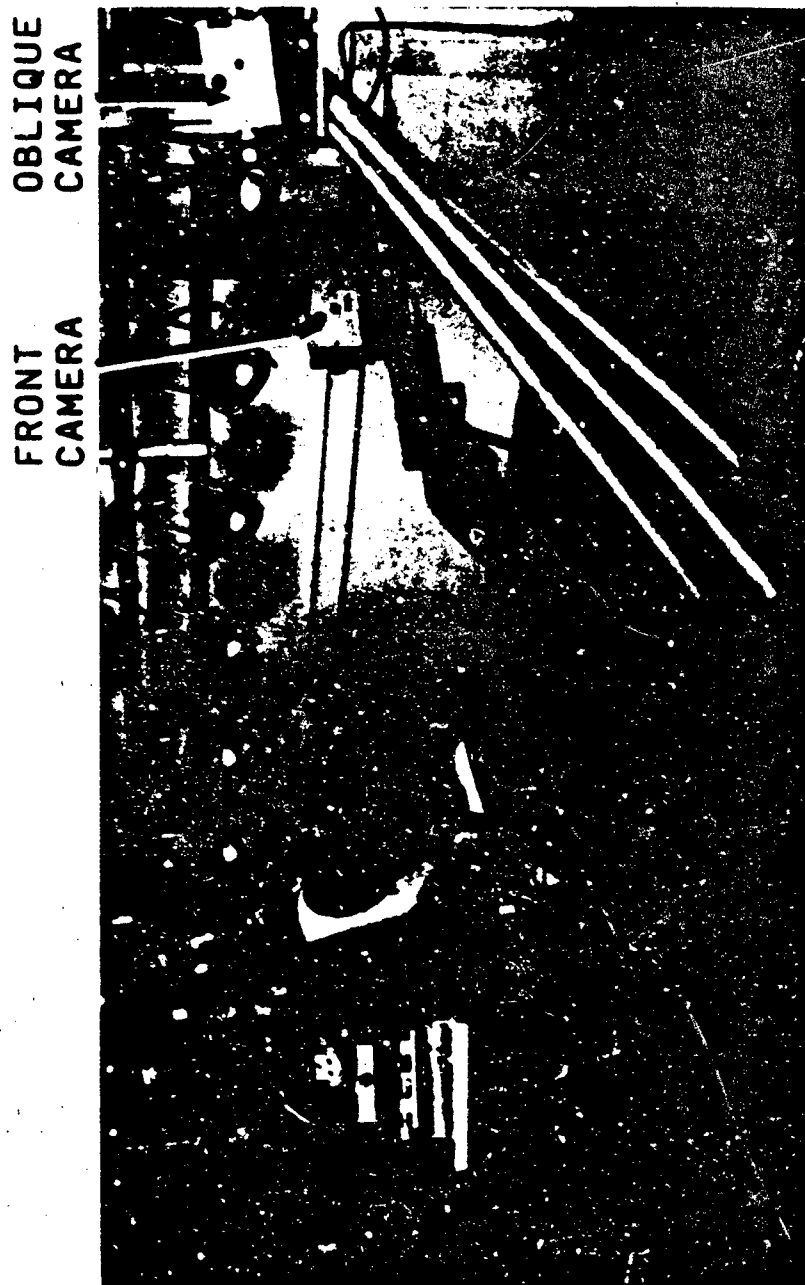


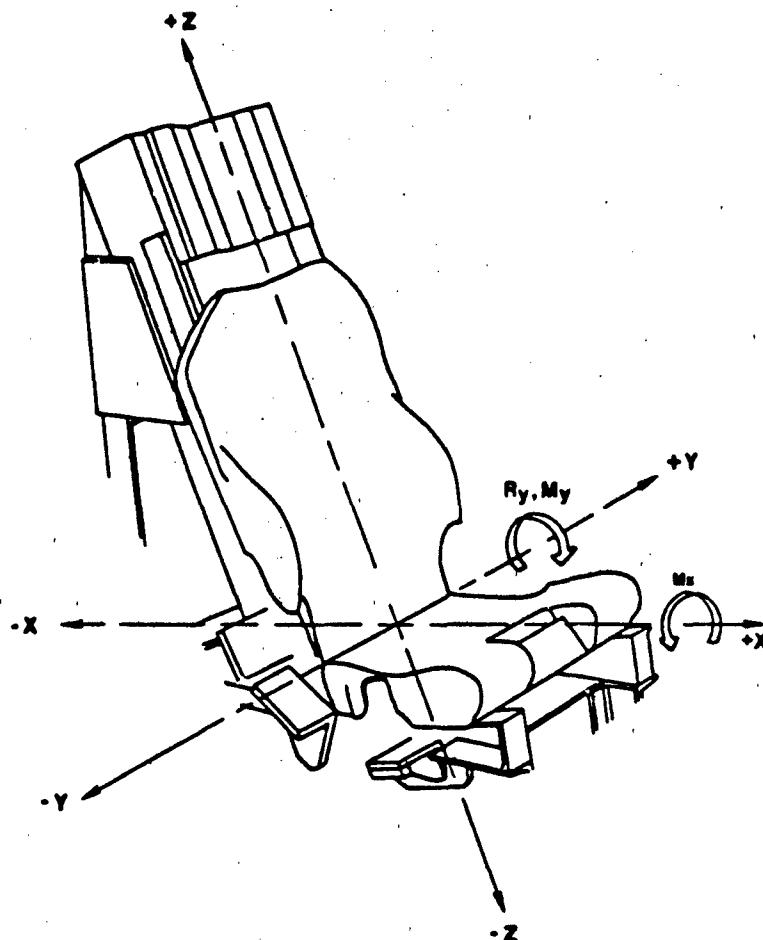
FIGURE A-3: +Gy CONFIGURATION SEAT FIXTURE/CAMERA LOCATIONS



FIGURE A-4: X-BAND-90 HARNESS/-Gx CONFIGURATION



FIGURE A-5: -Gx CONFIGURATION WITH EXTRA SEAT CUSHION



1. THE LINEAR ACCELEROMETERS WERE WIRED TO PROVIDE A POSITIVE OUTPUT VOLTAGE WHEN THE ACCELERATION EXPERIENCED BY THE ACCELEROMETER IS APPLIED IN THE +x, +y OR +z DIRECTION AS SHOWN.
2. THE ANGULAR  $R_y, M_y$  ACCELEROMETERS WERE WIRED TO PROVIDE A POSITIVE OUTPUT VOLTAGE WHEN THE ANGULAR ACCELERATION EXPERIENCED BY THE ANGULAR ACCELEROMETER IS APPLIED IN THE +y DIRECTION ACCORDING TO THE RIGHT HAND RULE AS SHOWN.
3. THE LOAD CELLS AND STRAIN GAGES WERE WIRED TO PROVIDE A POSITIVE OUTPUT VOLTAGE WHEN THE FORCE EXERTED BY THE LOAD CELL ON THE SUBJECT IS APPLIED IN THE +x, +y OR +z DIRECTION AS SHOWN.
4. THE  $M_x$  AND  $M_y$  TORQUE TRANSDUCERS WERE WIRED TO PROVIDE A POSITIVE OUTPUT VOLTAGE WHEN THE TORQUE EXPERIENCED BY THE TRANSDUCER IS APPLIED IN THE +x OR +y DIRECTION ACCORDING TO THE RIGHT HAND RULE AS SHOWN.

FIGURE A-6: AAMRL/BBP COORDINATE SYSTEM

CHEST  
ACCELEROMETERS

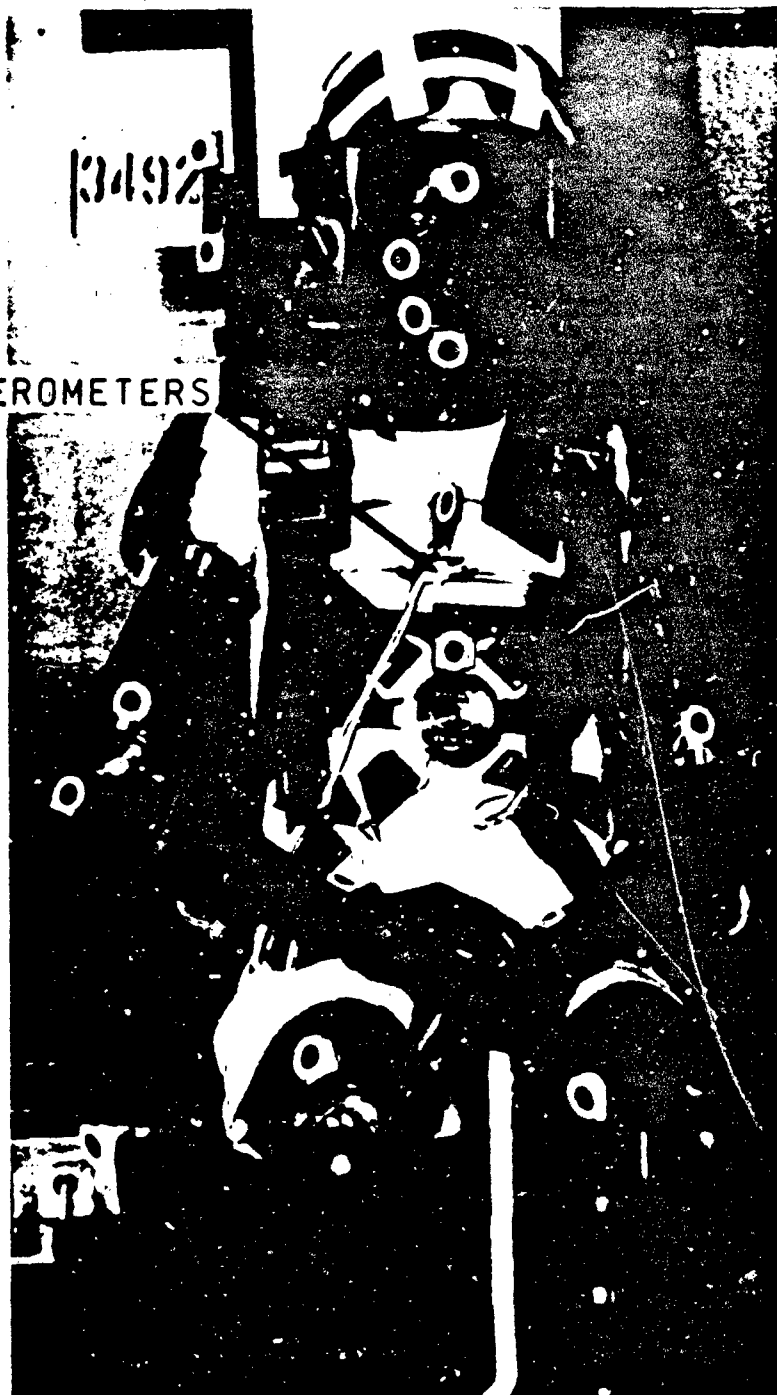
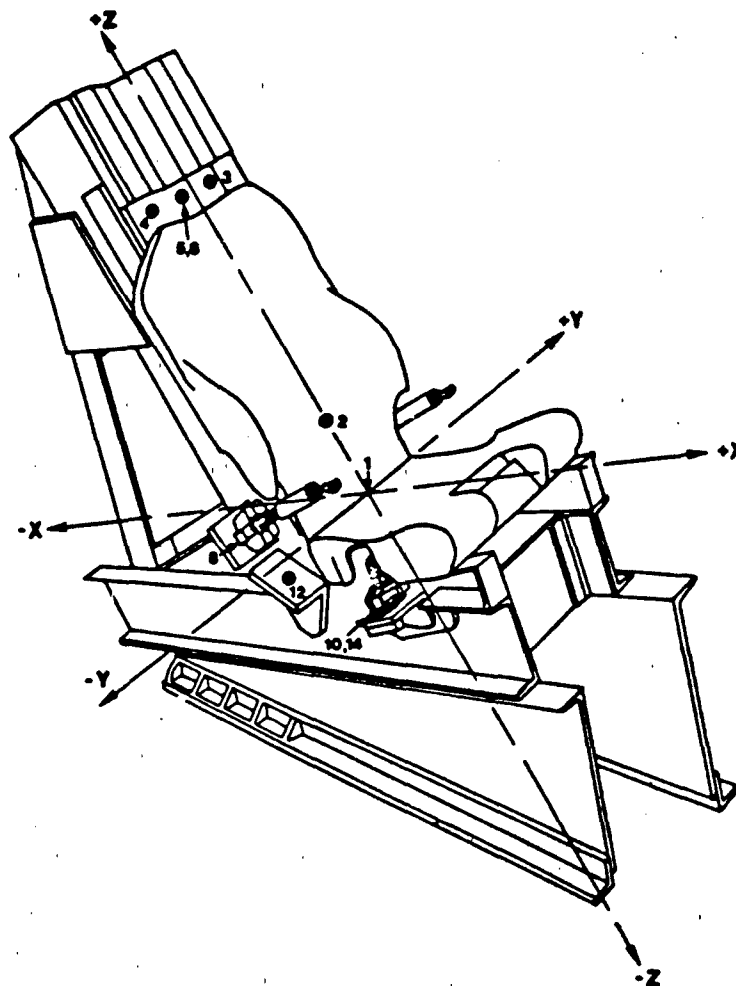


FIGURE A-7: CHEST ACCELEROMETER PACKAGE



**NO. DESCRIPTION**

- 1 SEAT REFERENCE POINT
- 2 SEAT BACK  $x$ ,  $y$  &  $z$  ACCELERATION
- 3 LEFT SHOULDER  $x$ ,  $y$  &  $z$  FORCE
- 4 RIGHT SHOULDER  $x$ ,  $y$  &  $z$  FORCE
- 5 SHOULDER ROLLER  $y$  &  $z$  FORCE
- 6 SHOULDER ROLLER TORQUE ( $M_x$ )
- X-BAND-90 HARNESS:
- 7 LEFT HORIZONTAL  $x$ ,  $y$  &  $z$  ANCHOR FORCE
- 8 RIGHT HORIZONTAL  $x$ ,  $y$  &  $z$  ANCHOR FORCE
- 9 LEFT VERTICAL  $x$ ,  $y$  &  $z$  ANCHOR FORCE
- 10 RIGHT VERTICAL  $x$ ,  $y$  &  $z$  ANCHOR FORCE

**NO. DESCRIPTION**

- X-BAND-45 HARNESS:
- 11 LEFT HORIZONTAL  $x$ ,  $y$  &  $z$  ANCHOR FORCE
  - 12 RIGHT HORIZONTAL  $x$ ,  $y$  &  $z$  ANCHOR FORCE
  - 13 LEFT VERTICAL  $x$ ,  $y$  &  $z$  ANCHOR FORCE
  - 14 RIGHT VERTICAL  $x$ ,  $y$  &  $z$  ANCHOR FORCE

**FOR REFERENCE ONLY:**

- 15 LEFT SHOULDER ROLLER CENTER
- 16 RIGHT SHOULDER ROLLER CENTER

NOTE: ITEMS 7, 9, 11, 13, 15 AND 16 ARE NOT SHOWN.

FIGURE A-8a: -G<sub>x</sub> TEST CONFIGURATION TRANSDUCER LOCATIONS AND DIMENSIONS  
(PAGE 1 OF 2)

ALL DIMENSIONS ARE REFERENCED TO THE SEAT REFERENCE POINT (SRP). THE SEAT REFERENCE POINT IS LOCATED AT THE INTERSECTION OF THE SEAT PAN CENTER LINE (x AXIS, 30 DEGREES ABOVE HORIZONTAL) AND THE SEAT BACK CENTER LINE (z AXIS, 30 DEGREES AFT OF VERTICAL).

NO.	CONTACT POINT DIMENSIONS IN INCHES (CM)			TRANSDUCER ATTACHMENT POINT IN INCHES (CM)		
	X	Y	Z	X	Y	Z
1	0.00 ( 0.00)	0.00 ( 0.00)	0.00 ( 0.00)	0.00 ( 0.00)	0.00 ( 0.00)	0.00 ( 0.00)
2	-----	-----	-----	-0.71 ( -0.28)	0.00 ( 0.00)	13.00 ( 5.12)
3	- 4.88 (-12.41)	2.63 ( 6.68)	28.06 ( 71.27)	- 2.78 ( -7.05)	2.63 ( 6.68)	28.06 ( 71.27)
4	- 4.88 (-12.41)	- 2.46 ( -6.26)	28.06 ( 71.27)	- 2.78 ( -7.05)	- 2.46 ( -6.26)	28.06 ( 71.27)
5	-----	-----	-----	- 2.98 ( -7.58)	0.48 ( 1.23)	27.51 ( 69.88)
6	-----	-----	-----	- 2.36 ( -6.00)	0.48 ( 1.23)	27.51 ( 69.88)
7	- 3.38 ( -8.58)	7.98 ( 20.27)	3.13 ( 7.94)	5.71 ( 14.50)	7.98 ( 20.27)	3.93 ( 9.98)
8	- 3.38 ( -8.58)	- 8.11 (-20.59)	3.13 ( 7.94)	5.71 ( 14.50)	- 8.11 (-20.59)	3.93 ( 9.98)
9	7.48 ( 19.00)	8.08 ( 20.52)	- 4.28 (-10.87)	7.48 ( 19.00)	8.08 ( 20.52)	- 2.52 ( -6.40)
10	7.48 ( 19.00)	- 7.97 (-20.25)	- 4.28 (-10.87)	7.48 ( 19.00)	- 7.97 (-20.25)	- 2.52 ( -6.40)
11	- 1.97 ( -5.00)	8.30 ( 21.07)	0.26 ( 0.66)	- 0.67 ( -1.70)	8.30 ( 21.07)	1.17 ( 2.96)
12	- 1.97 ( -5.00)	- 8.15 (-20.70)	0.26 ( 0.66)	- 0.67 ( -1.70)	- 8.15 (-20.70)	1.17 ( 2.96)
13	7.87 ( 20.00)	8.12 ( 20.62)	- 3.37 ( -8.57)	7.87 ( 20.00)	- 8.12 ( 20.62)	- 1.67 ( -4.23)
14	7.87 ( 20.00)	- 8.06 (-20.47)	- 3.37 ( -8.57)	7.87 ( 20.00)	- 8.06 (-20.47)	- 1.67 ( -4.23)
15	-----	-----	-----	0.57 ( 1.45)	- 2.48 ( -6.29)	27.31 ( 69.36)
16	-----	-----	-----	0.57 ( 1.45)	2.54 ( 6.46)	27.31 ( 69.36)

SEE FIGURE A-8a FOR DESCRIPTIONS OF TRANSDUCER ITEM NUMBERS

THE SEAT BACK ACCELEROMETER MEASUREMENTS (ITEM 2) ARE TAKEN AT THE CENTER OF THE ACCELEROMETER BLOCK.

SHOULDER ROLLER y AND z FORCE MEASUREMENTS (ITEM 5) ARE TAKEN AT THE MIDPOINT OF THE SHOULDER ROLLER y AND z FORCE STRAIN GAGES.

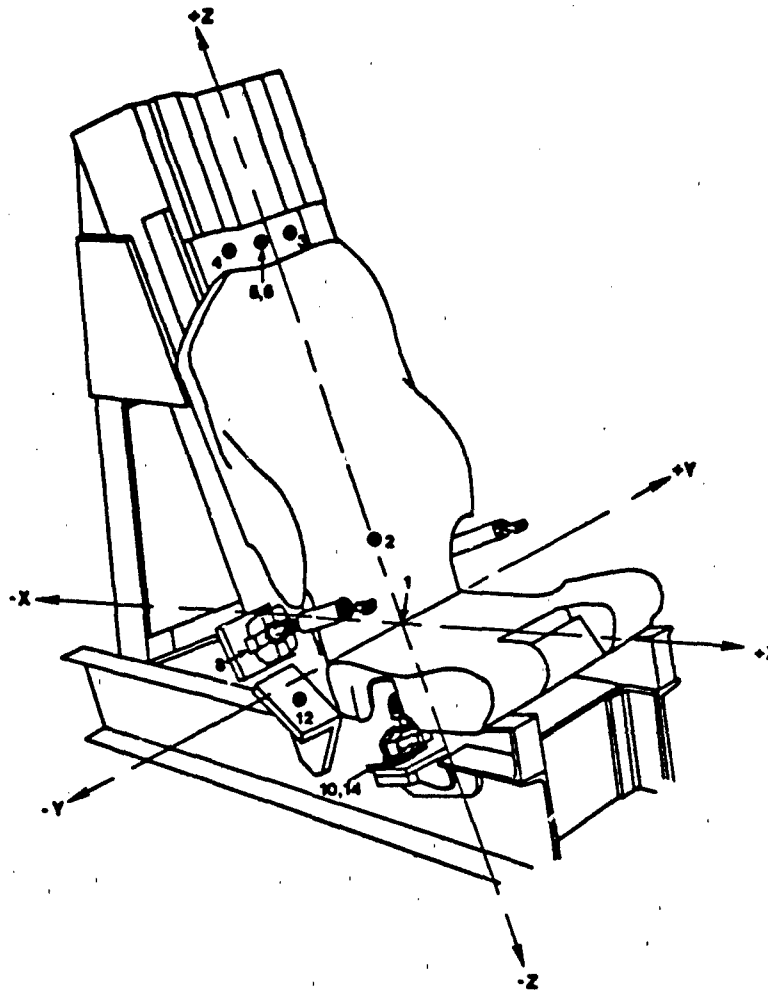
SHOULDER ROLLER TORQUE (Mx) MEASUREMENTS (ITEM 6) ARE TAKEN AT THE MIDPOINT OF THE SHOULDER ROLLER Mx TORQUE STRAIN GAGES.

THE CONTACT POINT IS THE POINT ON THE LOAD CELL AT WHICH THE EXTERNAL FORCE IS APPLIED.

THE LOAD CELL ATTACHMENT POINT IS THE POINT AT WHICH THE HARNESS STRAP IS ATTACHED TO THE LOAD CELL.

FIGURE A-8b: -Gx TEST CONFIGURATION TRANSDUCER LOCATIONS AND DIMENSIONS (PAGE 2 OF 2)





**NO. DESCRIPTION**

- 1 SEAT REFERENCE POINT
- 2 SEAT BACK x, y & z ACCELERATION
- 3 LEFT SHOULDER x, y & z FORCE
- 4 RIGHT SHOULDER x, y & z FORCE
- 5 SHOULDER ROLLER y & z FORCE
- 6 SHOULDER ROLLER TORQUE (Mx)
- X-BAND-90 HARNESS:
- 7 LEFT HORIZONTAL x, y & z ANCHOR FORCE
- 8 RIGHT HORIZONTAL x, y & z ANCHOR FORCE
- 9 LEFT VERTICAL x, y & z ANCHOR FORCE
- 10 RIGHT VERTICAL x, y & z ANCHOR FORCE

**NO. DESCRIPTION**

- X-BAND-45 HARNESS:
- 11 LEFT HORIZONTAL x, y & z ANCHOR FORCE
- 12 RIGHT HORIZONTAL x, y & z ANCHOR FORCE
- 13 LEFT VERTICAL x, y & z ANCHOR FORCE
- 14 RIGHT VERTICAL x, y & z ANCHOR FORCE

- FOR REFERENCE ONLY:
- 15 LEFT SHOULDER ROLLER CENTER
  - 16 RIGHT SHOULDER ROLLER CENTER

NOTE: ITEMS 7, 9, 11, 13, 15 AND 16 ARE NOT SHOWN.

FIGURE A-9a: +Gy TEST CONFIGURATION TRANSDUCER LOCATIONS AND DIMENSIONS  
(PAGE 1 OF 2)

ALL DIMENSIONS ARE REFERENCED TO THE SEAT REFERENCE POINT (SRP). THE SEAT REFERENCE POINT IS LOCATED AT THE INTERSECTION OF THE SEAT PAN CENTER LINE (x AXIS, 13 DEGREES ABOVE HORIZONTAL) AND THE SEAT BACK CENTER LINE (z AXIS, 13 DEGREES AFT OF VERTICAL).

NO.	CONTACT POINT DIMENSIONS IN INCHES (CM)			TRANSDUCER ATTACHMENT POINT IN INCHES (CM)		
	X	Y	Z	X	Y	Z
1	0.00 ( 0.00)	0.00 ( 0.00)	0.00 ( 0.00)	0.00 ( 0.00)	0.00 ( 0.00)	0.00 ( 0.00)
2	-----	-----	-----	-0.71 ( -0.28)	0.00 ( 0.00)	13.00 ( 5.12)
3	- 4.88 (-12.41)	2.63 ( 6.68)	28.06 ( 71.27)	- 2.78 ( -7.05)	2.63 ( 6.68)	28.06 ( 71.27)
4	- 4.88 (-12.41)	- 2.46 ( -6.26)	28.06 ( 71.27)	- 2.78 ( -7.05)	- 2.46 ( -6.26)	28.06 ( 71.27)
5	-----	-----	-----	- 2.98 ( -7.58)	0.48 ( 1.23)	27.51 ( 69.88)
6	-----	-----	-----	- 2.36 ( -6.00)	0.48 ( 1.23)	27.51 ( 69.88)
7	- 3.38 ( -8.58)	7.98 ( 20.27)	3.13 ( 7.94)	5.71 ( 14.50)	7.98 ( 20.27)	3.93 ( 9.98)
8	- 3.38 ( -8.58)	- 8.11 (-20.59)	3.13 ( 7.94)	5.71 ( 14.50)	- 8.11 (-20.59)	3.93 ( 9.98)
9	7.48 ( 19.00)	8.08 ( 20.52)	- 4.28 (-10.87)	7.48 ( 19.00)	8.08 ( 20.52)	- 2.52 ( -6.40)
10	7.48 ( 19.00)	- 7.97 (-20.25)	- 4.28 (-10.87)	7.48 ( 19.00)	- 7.97 (-20.25)	- 2.52 ( -6.40)
11	- 1.97 ( -5.00)	8.30 ( 21.07)	0.26 ( 0.66)	- 0.67 ( -1.70)	8.30 ( 21.07)	1.17 ( 2.96)
12	- 1.97 ( -5.00)	- 8.15 (-20.70)	0.26 ( 0.66)	- 0.67 ( -1.70)	- 8.15 (-20.70)	1.17 ( 2.96)
13	7.87 ( 20.00)	8.12 ( 20.62)	- 3.37 ( -8.57)	7.87 ( 20.00)	- 8.12 ( 20.62)	- 1.67 ( -4.23)
14	7.87 ( 20.00)	- 8.06 (-20.47)	- 3.37 ( -8.57)	7.87 ( 20.00)	- 8.06 (-20.47)	- 1.67 ( -4.23)
15	-----	-----	-----	0.57 ( 1.45)	- 2.48 ( -6.29)	27.31 ( 69.36)
16	-----	-----	-----	0.57 ( 1.45)	2.54 ( 6.46)	27.31 ( 69.36)

SEE FIGURE A-9a FOR DESCRIPTIONS OF TRANSDUCER ITEM NUMBERS

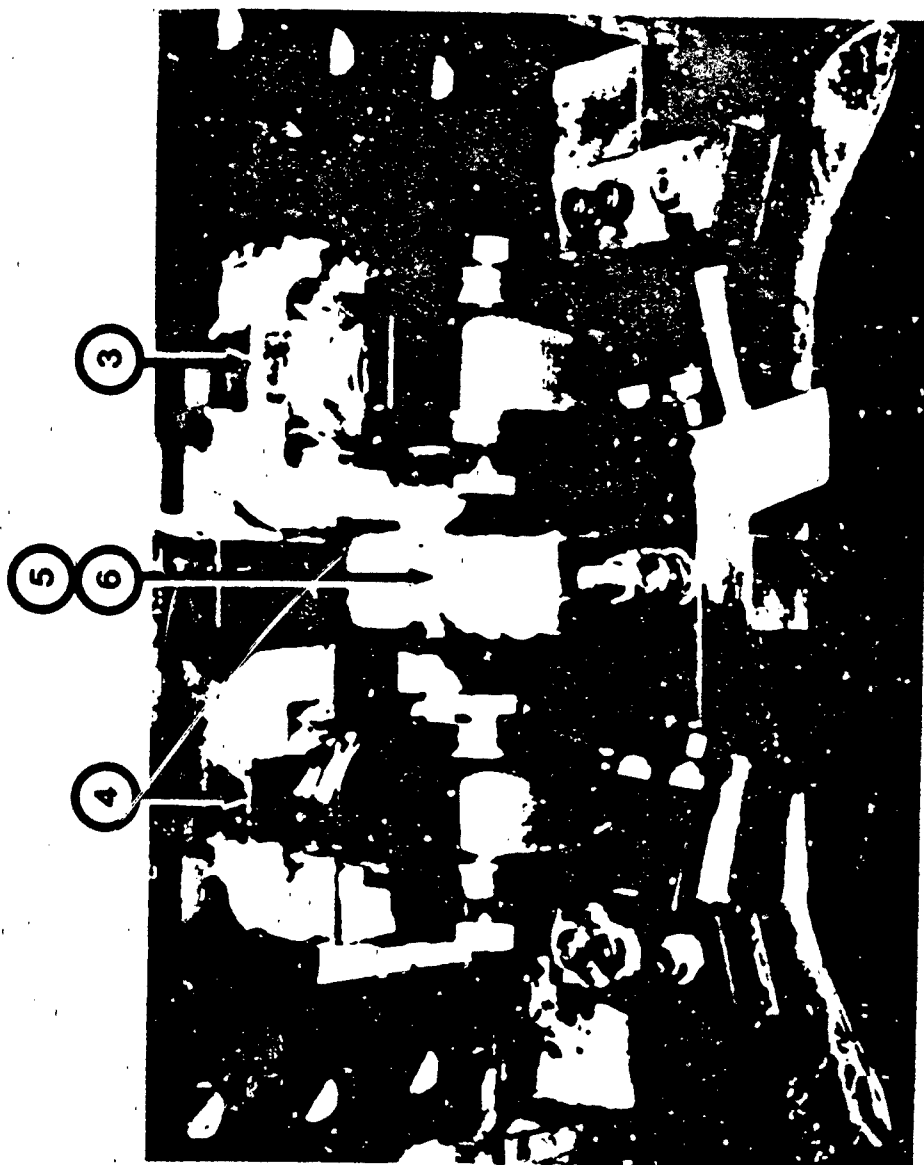
THE SEAT BACK ACCELEROMETER MEASUREMENTS (ITEM 2) ARE TAKEN AT THE CENTER OF THE ACCELEROMETER BLOCK. SHOULDER ROLLER y AND z FORCE MEASUREMENTS (ITEM 5) ARE TAKEN AT THE MIDPOINT OF THE SHOULDER ROLLER y AND z FORCE STRAIN GAGES.

SHOULDER ROLLER TORQUE (Mx) MEASUREMENTS (ITEM 6) ARE TAKEN AT THE MIDPOINT OF THE SHOULDER ROLLER Mx TORQUE STRAIN GAGES.

THE CONTACT POINT IS THE POINT ON THE LOAD CELL AT WHICH THE EXTERNAL FORCE IS APPLIED.

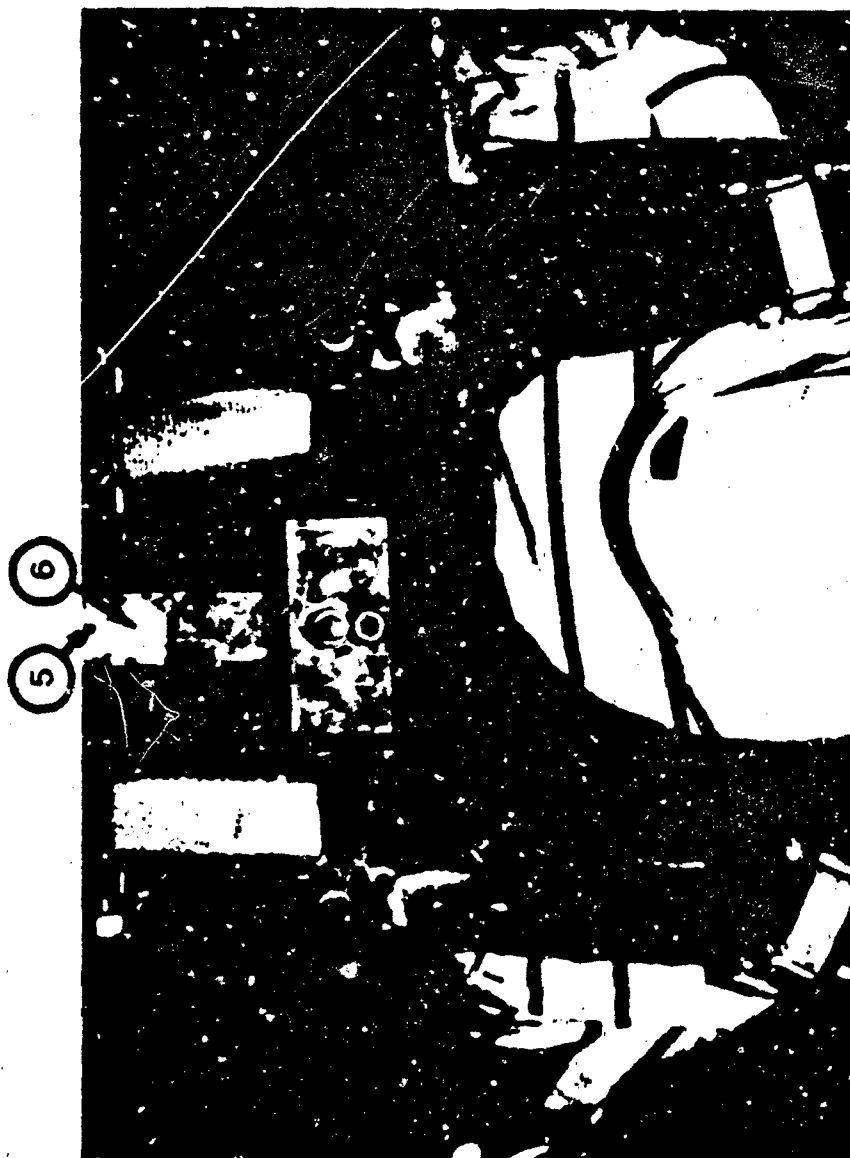
THE LOAD CELL ATTACHMENT POINT IS THE POINT AT WHICH THE HARNESS STRAP IS ATTACHED TO THE LOAD CELL.

FIGURE A-9b: +Gy TEST CONFIGURATION TRANSDUCER LOCATIONS AND DIMENSIONS (PAGE 2 OF 2)



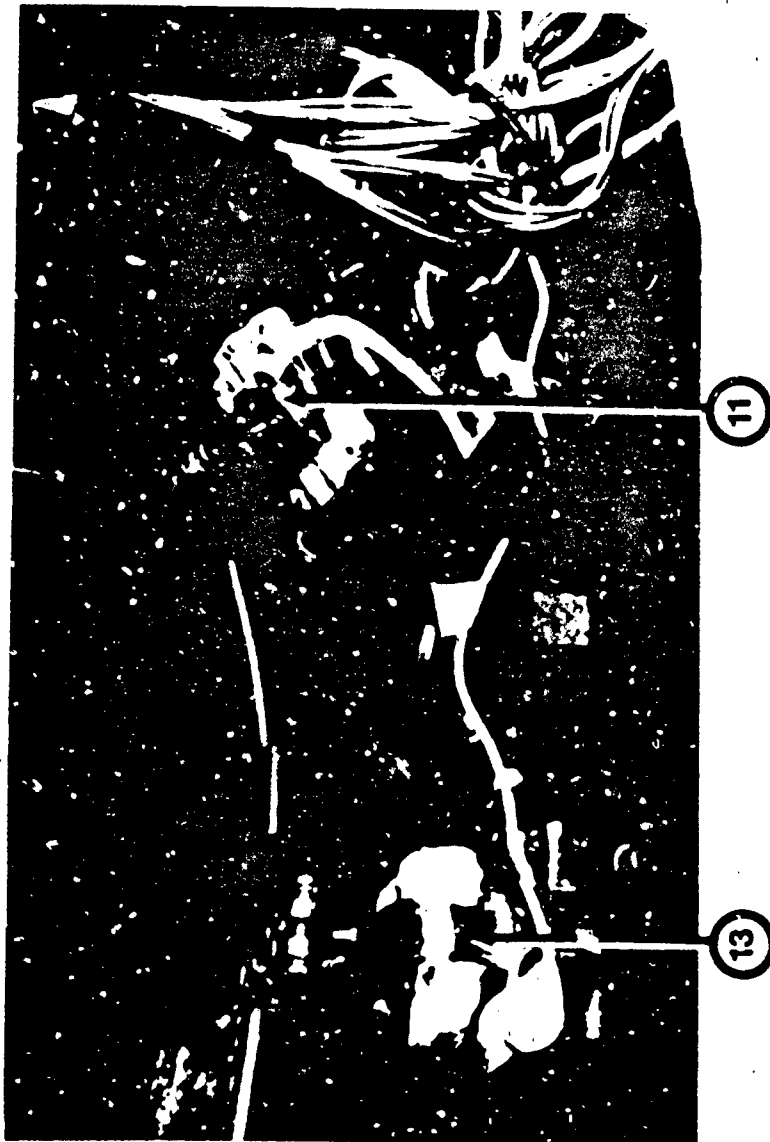
REFER TO FIGURE 8a FOR A DESCRIPTION OF THE TRANSDUCER ITEM NUMBERS

FIGURE A-10: LEFT/RIGHT SHOULDER ANCHOR LOAD CELLS



REFER TO FIGURE A-8a FOR A DESCRIPTION OF THE TRANSDUCER ITEM NUMBERS

FIGURE A-11: T-BAR INSTRUMENTATION



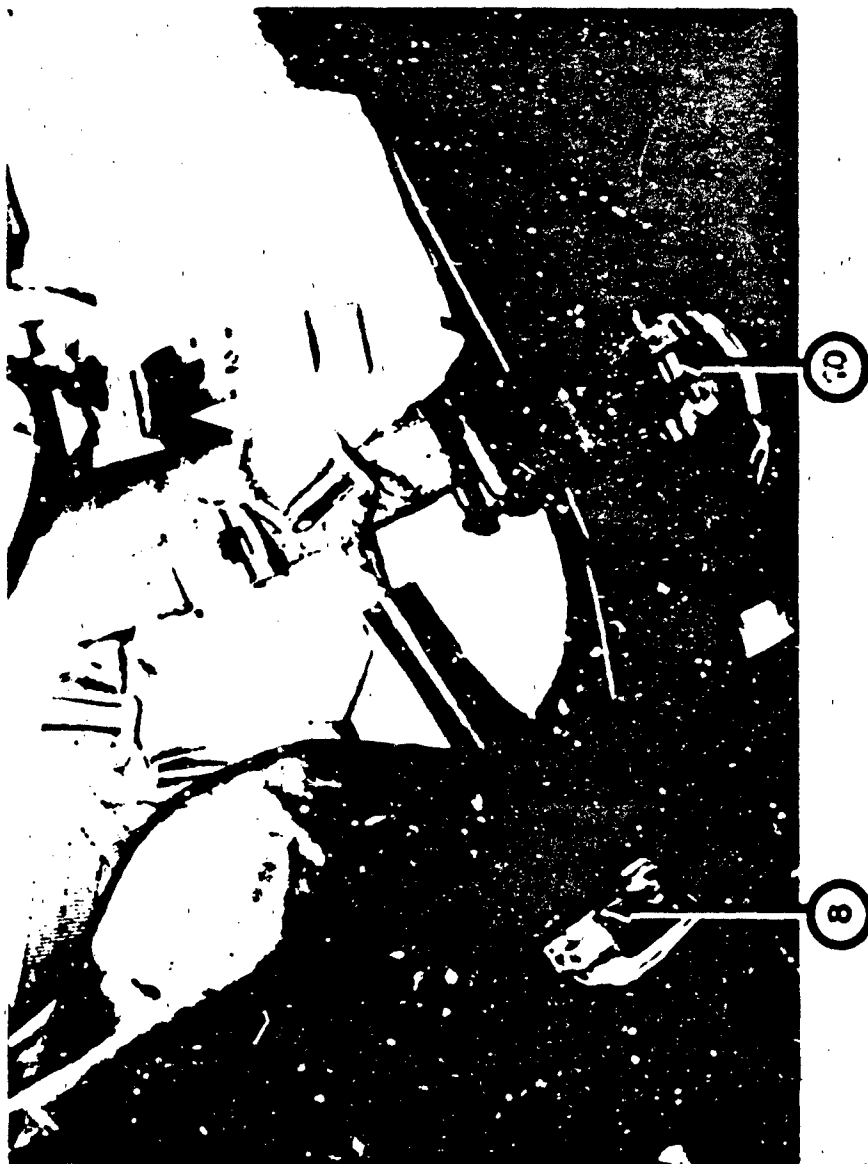
REFER TO FIGURE A-9a FOR A DESCRIPTION OF THE TRANSDUCER ITEM NUMBERS

FIGURE A-12: LEFT HORIZONTAL/VERTICAL ANCHOR LOAD CELLS  
+Gy CONFIGURATION/X-BAND-45 HARNESS LOCATIONS



REFER TO FIGURE A-9a FOR A DESCRIPTION OF THE TRANSDUCER ITEM NUMBERS

FIGURE A-13: RIGHT HORIZONTAL/VERTICAL ANCHOR LOAD CELLS  
+Gy CONFIGURATION/X-BAND-45 HARNESS LOCATIONS



REFER TO FIGURE A-8a FOR A DESCRIPTION OF THE TRANSDUCER ITEM NUMBERS

FIGURE A-14: RIGHT HORIZONTAL/VERTICAL ANCHOR LOAD CELLS  
-Gx CONFIGURATION/X-BAND-90 HARNESS LOCATIONS

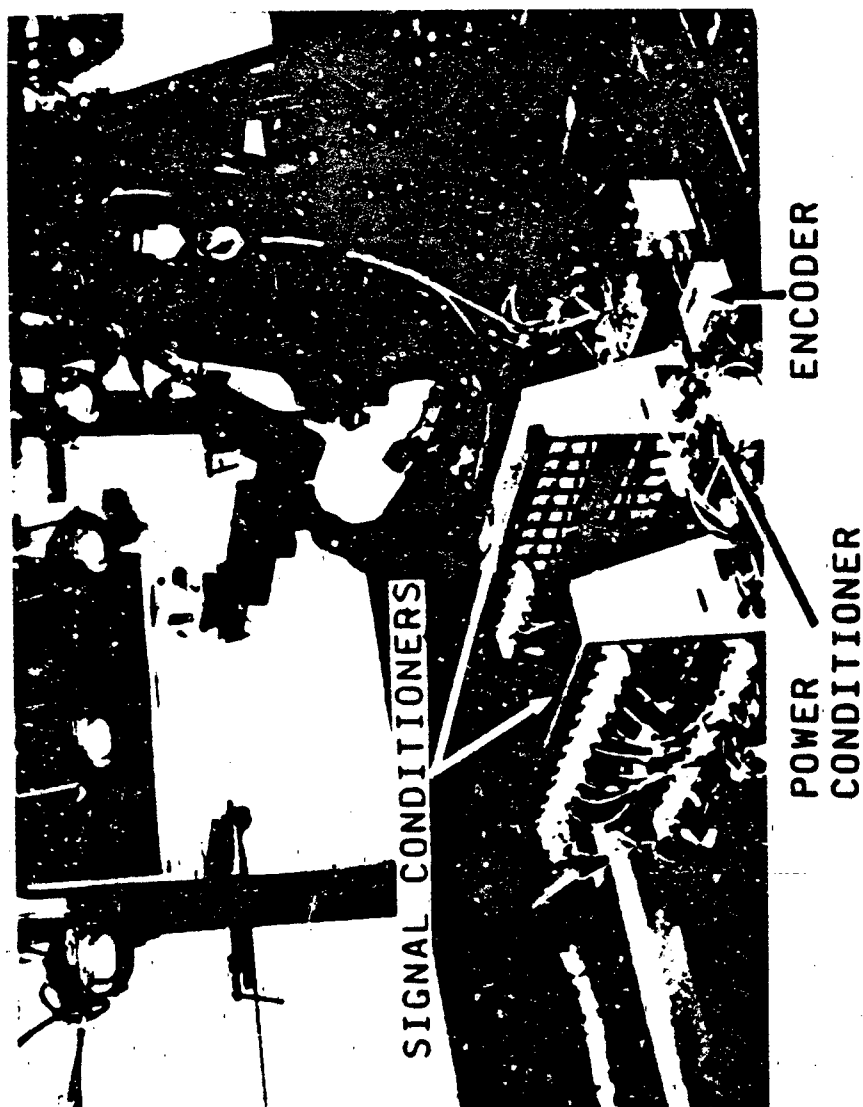
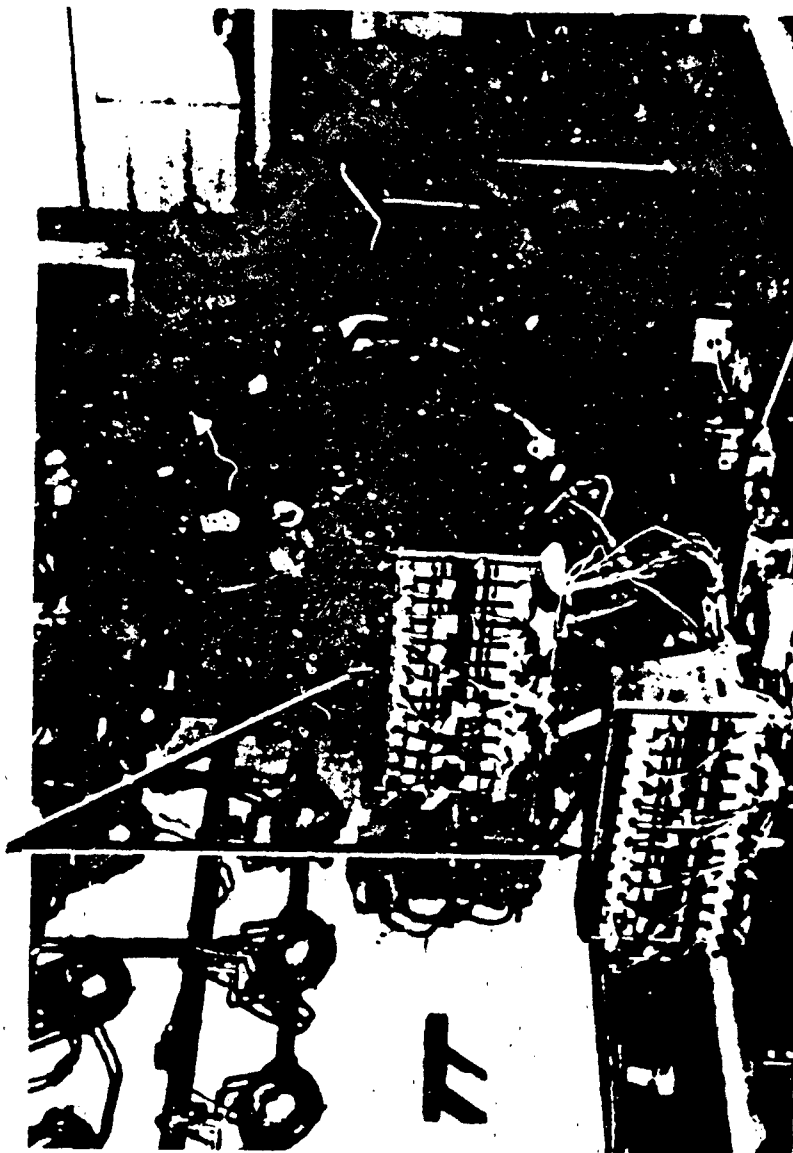


FIGURE A-15: ADACS INSTALLATION/+Gy CONFIGURATION



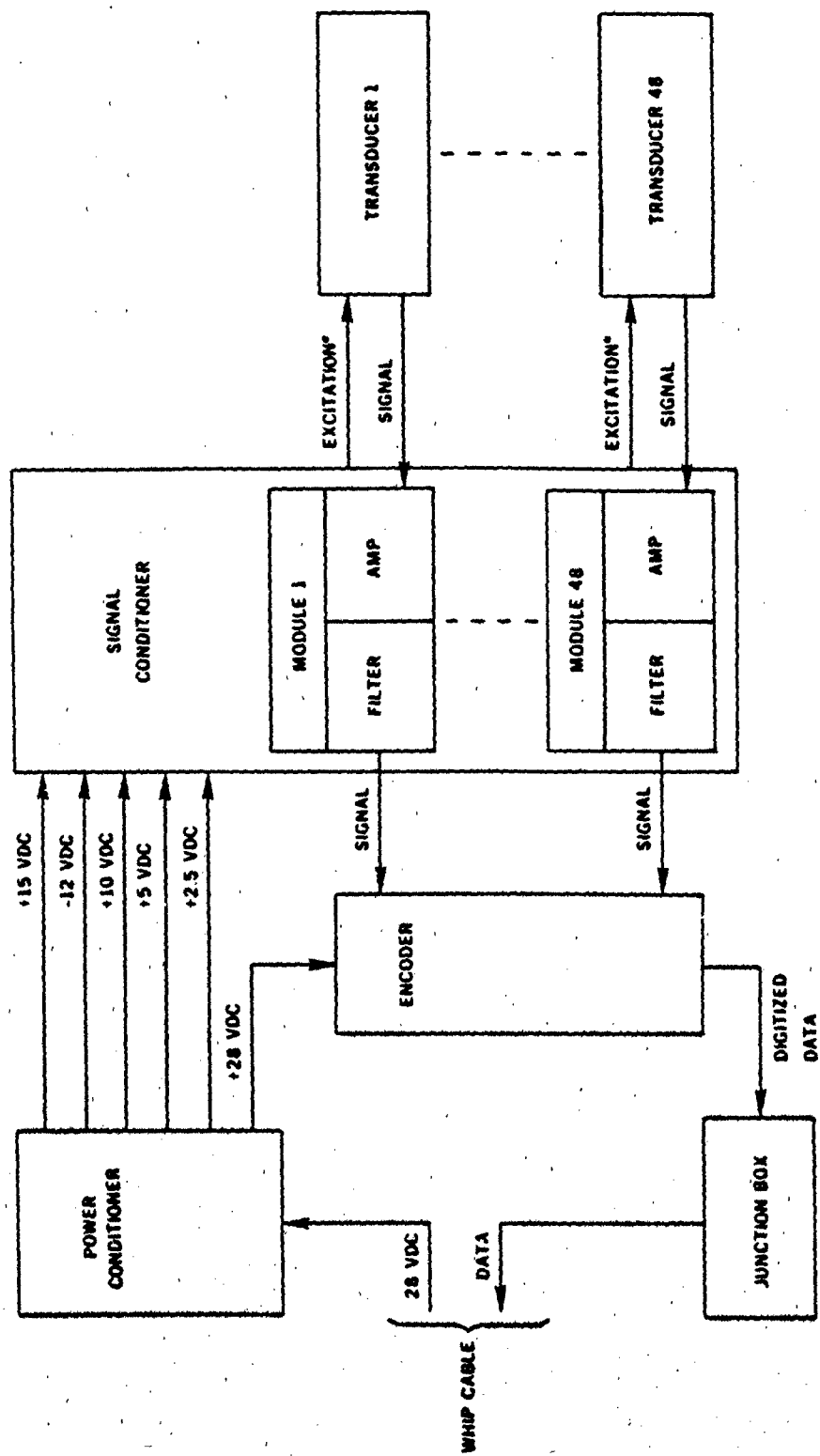
SIGNAL CONDITIONERS



ENCODER

POWER  
CONDITIONER

FIGURE A-16: ADACS INSTALLATION/-Gx CONFIGURATION



\* +10 OR +5 VDC. FOR BRIDGE-TYPE TRANSUCERS ONLY.

FIGURE A-17: AUTOMATIC DATA ACQUISITION AND CONTROL SYSTEM

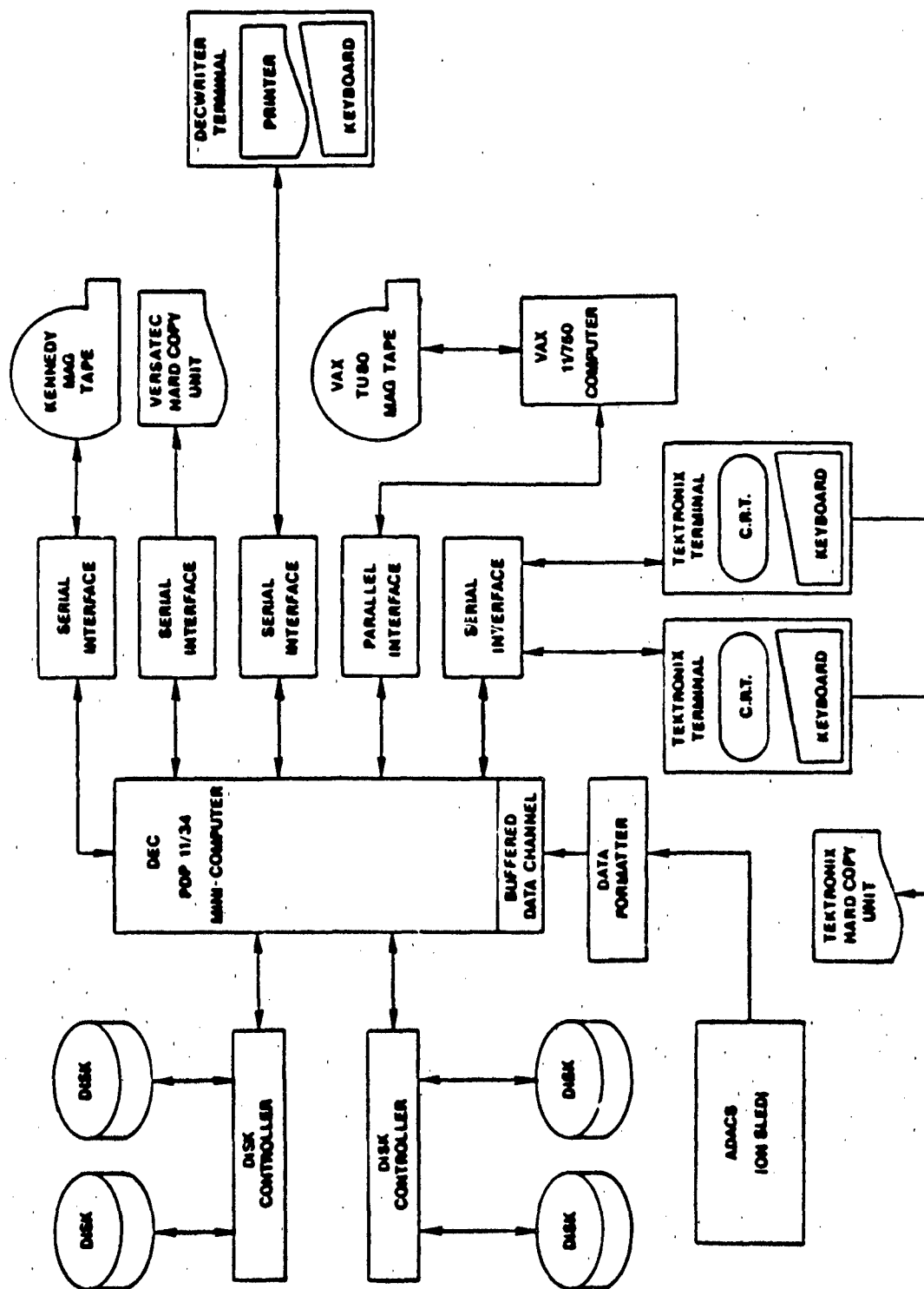
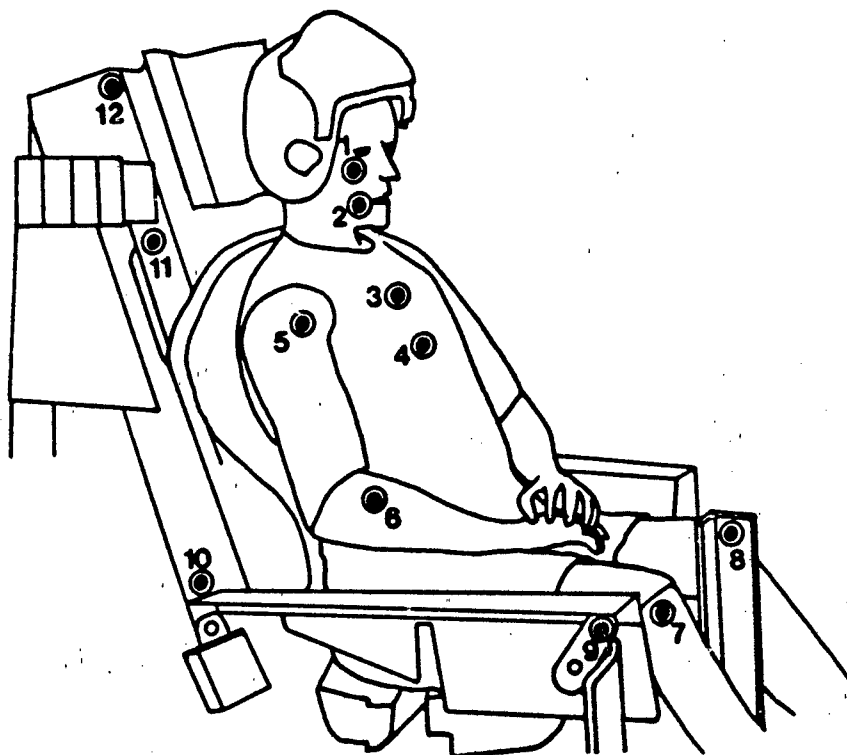


FIGURE A-18: DATA ACQUISITION AND STORAGE SYSTEM BLOCK DIAGRAM



ALL DIMENSIONS ARE REFERENCED TO THE SEAT REFERENCE POINT (SRP). THE SEAT REFERENCE POINT IS LOCATED AT THE INTERSECTION OF THE SEAT PAN CENTER LINE (x AXIS, 13 DEGREES ABOVE HORIZONTAL) AND THE SEAT BACK CENTER LINE (z AXIS, 13 DEGREES AFT OF VERTICAL).

	DESCRIPTION	DIMENSIONS IN FEET		
		<u>x</u>	<u>y</u>	<u>z</u>
1.	CHEEK	-	-	-
2.	MOUTH	-	-	-
3.	UPPER CHEST	-	-	-
4.	LOWER CHEST	-	-	-
5.	SHOULDER	-	-	-
6.	ELBOW	-	-	-
7.	KNEE	-	-	-
8.	CENTER BRACKET	2.1635	0.1322	0.3608
9.	FORE SIDE PLATE	1.9841	-1.0072	0.2881
10.	AFT SIDE PLATE	-0.2387	-0.9646	0.7383
11.	RIGHT CENTER FRAME	-0.2020	-0.6037	2.4942
12.	RIGHT UPPER FRAME	-0.1303	-0.5709	3.2349

FIGURE A-19: +Gy TEST CONFIGURATION FIDUCIAL TARGET LOCATIONS

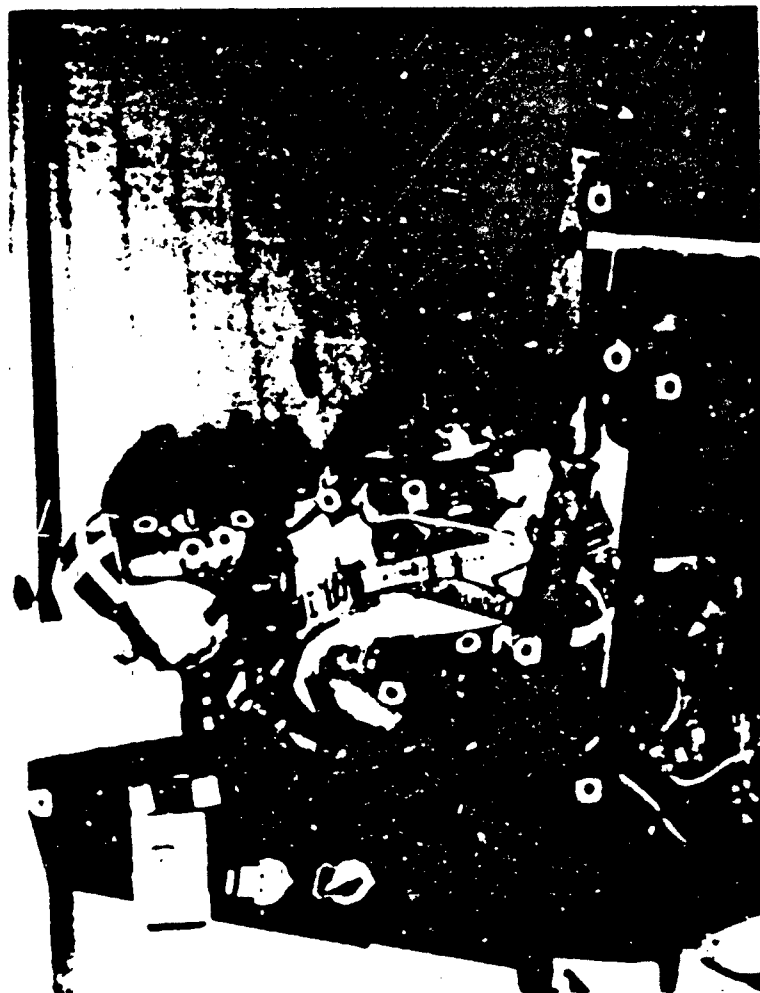
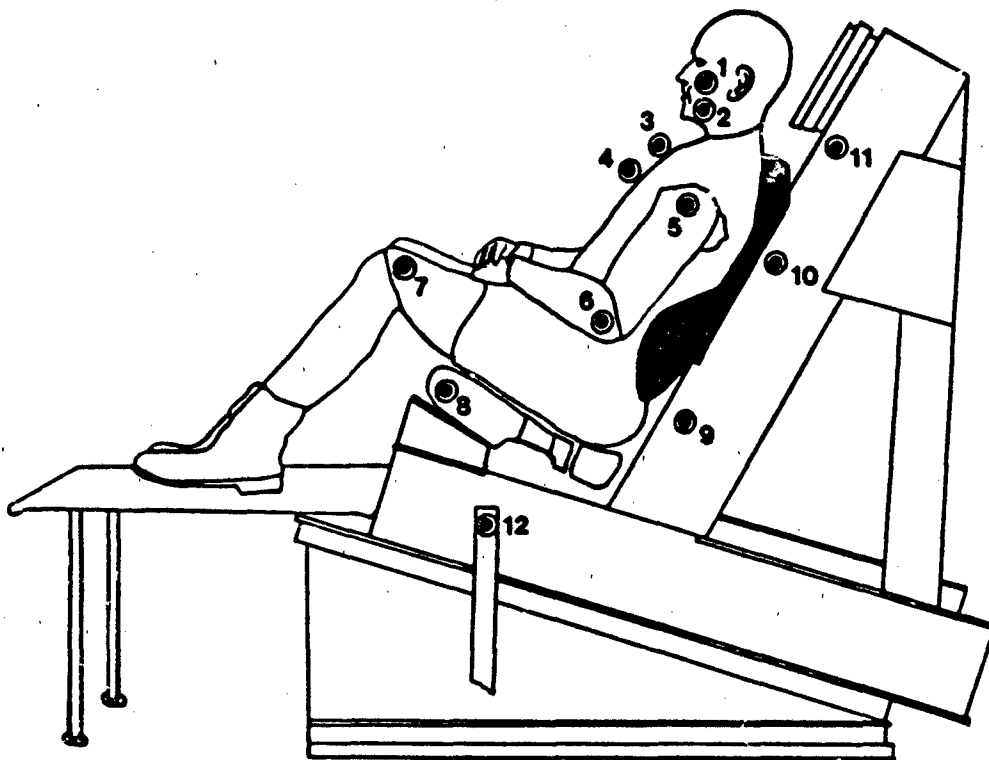


FIGURE A-20: +6y CONFIGURATION FIDUCIAL TARGETS



ALL DIMENSIONS ARE REFERENCED TO THE SEAT REFERENCE POINT (SRP). THE SEAT REFERENCE POINT IS LOCATED AT THE INTERSECTION OF THE SEAT PAN CENTER LINE (x AXIS, 30 DEGREES ABOVE HORIZONTAL) AND THE SEAT BACK CENTER LINE (z AXIS, 30 DEGREES AFT OF VERTICAL).

DESCRIPTION	DIMENSIONS IN FEET		
	<u>x</u>	<u>y</u>	<u>z</u>
1. CHEEK	-	-	-
2. MOUTH	-	-	-
3. UPPER CHEST	-	-	-
4. LOWER CHEST	-	-	-
5. SHOULDER	-	-	-
6. ELBOW	-	-	-
7. KNEE	-	-	-
8. SEAT PAN	1.2216	0.7136	-0.4663
9. LOAD CELL MOUNT	-0.4143	0.8527	0.3369
10. SEAT BACK	-0.0006	0.6699	1.4104
11. NUMBER PLATE	-0.0053	0.4808	2.4526
12. AFT BRACKET ARM	0.6245	2.1675	-0.5590

FIGURE A-21: -6x TEST CONFIGURATION FIDUCIAL TARGET LOCATIONS

OBLIQUE  
CAMERA



SIDE  
CAMERA

FIGURE A-22: -6x CONFIGURATION FIDUCIAL TARGETS/CAMERA LOCATIONS

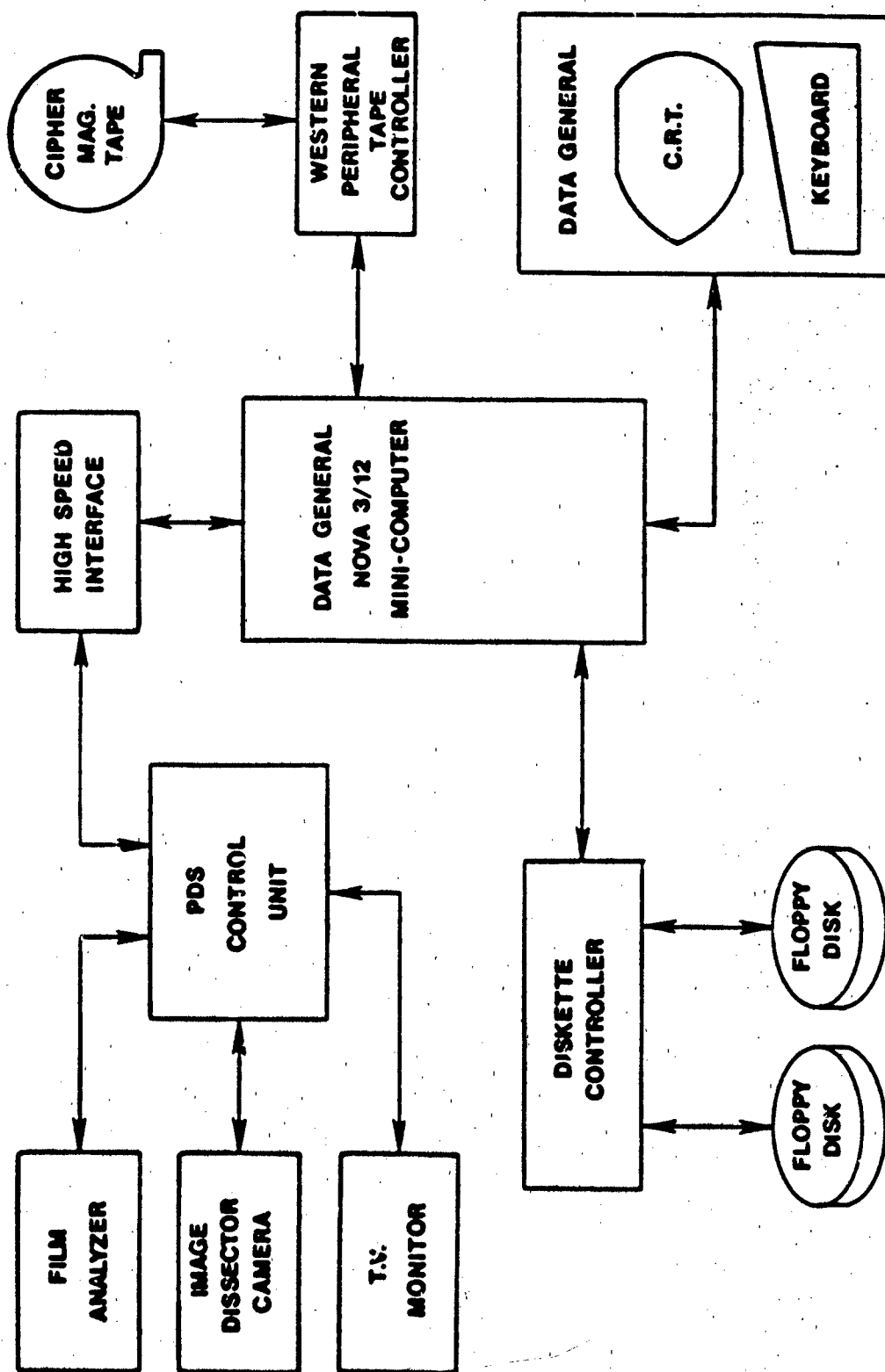


FIGURE A-23: AUTOMATIC FILM READER



## APPENDIX B

### ADACS Data Summaries and Graphs for ADAM Tests

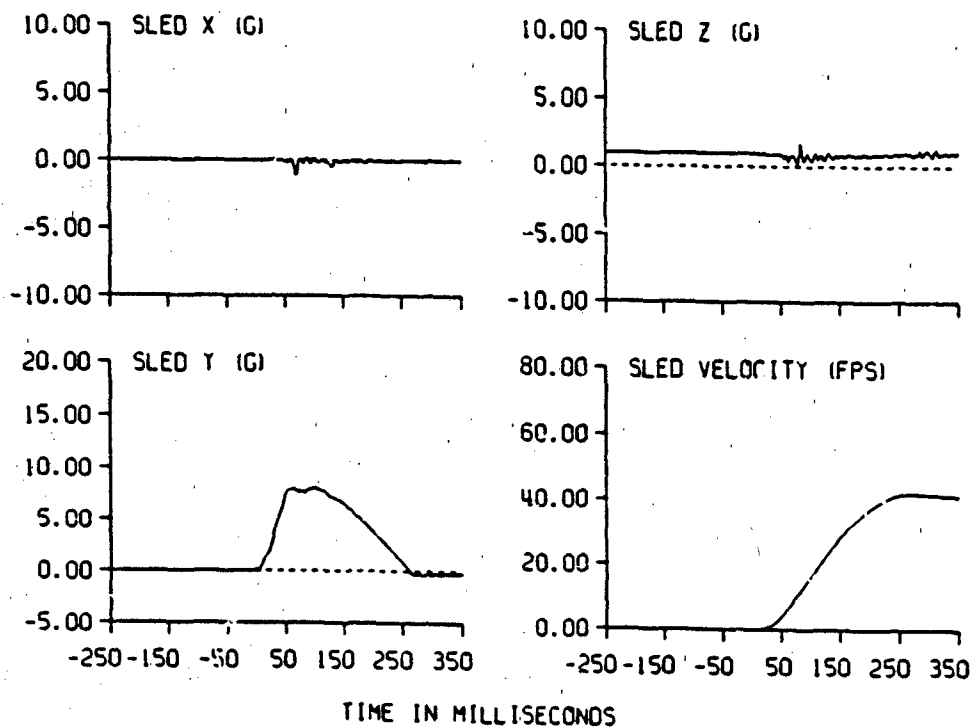
CHIA STUDY +GY TEST: 3484 SUBJ: ADAM-S WT: 143.0 NOM G: 8.0 CELL: A

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK TIME (MS)				-254.	
2.5V EXT POWER (VOLTS)	2.50	2.50	2.50	0.	1.
10V EXT POWER (VOLTS)	10.00	10.00	10.00	0.	1.
SLED ACCELERATION (G)					
X AXIS	-0.02	0.19	-1.11	88.	69.
Y AXIS	0.01	8.10	-0.43	100.	312.
Z AXIS	0.99	1.67	0.14	83.	78.
SEAT ACCELERATION (G)					
X AXIS	0.23	1.26	-1.81	79.	71.
Y AXIS	-0.01	11.22	-0.76	87.	304.
Z AXIS	0.94	2.35	-0.37	85.	80.
RESULTANT	0.97	11.37	0.79	87.	278.
CHEST ACCELERATION (G)					
X AXIS	0.28	5.56	-4.07	70.	105.
Y AXIS	0.29	18.34	-1.46	72.	306.
Z AXIS	0.98	5.96	-3.18	90.	120.
RESULTANT	1.06	19.04	0.85	71.	262.
RY (RAD/SEC2)	-5.31	1027.42	-1345.49	80.	94.
SLED VELOCITY (FPS)	-0.02	42.04	-0.02	272.	0.
SHOULDER STRAP FORCES (LB)					
LEFT X AXIS	-6.04	4.01	-15.63	57.	73.
LEFT Y AXIS	2.74	35.59	-0.09	83.	326.
LEFT Z AXIS	3.94	8.49	1.61	74.	56.
LEFT RESULTANT	7.75	36.55	3.53	84.	303.
RIGHT X AXIS	-5.32	1.98	-197.66	331.	98.
RIGHT Y AXIS	1.19	42.04	-1.19	127.	300.
RIGHT Z AXIS	1.27	2.64	-2.44	27.	57.
RIGHT RESULTANT	5.64	201.18	0.10	99.	316.
SHOULDER ROLLER					
Y AXIS FORCE (LB)	1.95	152.78	-8.85	128.	345.
Z AXIS FORCE (LB)	11.36	125.93	2.16	95.	304.
X AXIS TORQUE (IN-LB)	4.57	322.38	-19.18	93.	342.

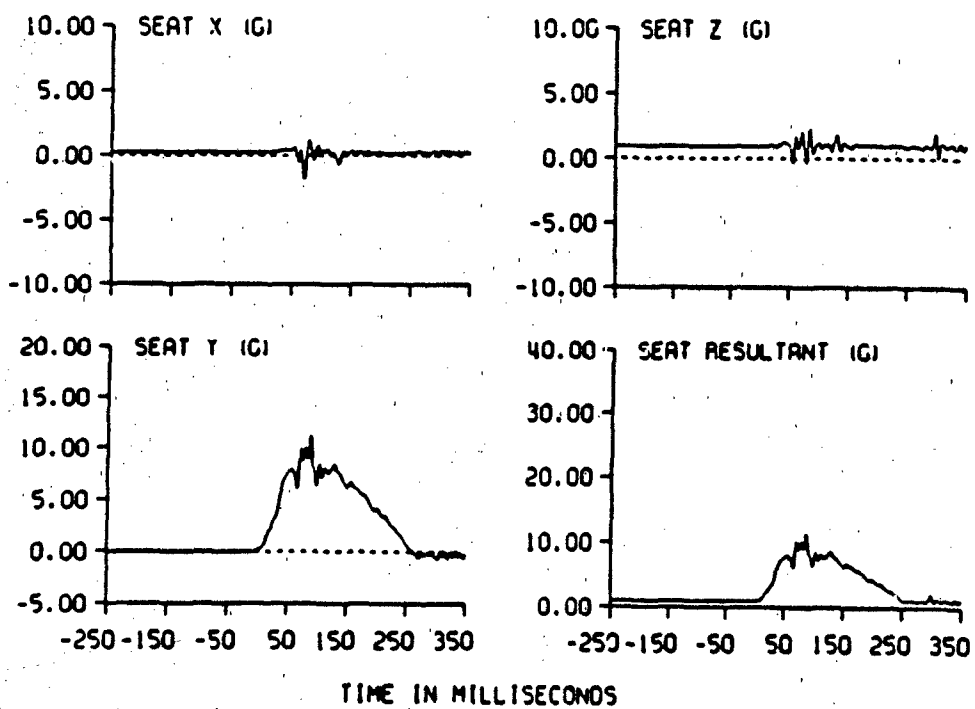
CHIA STUDY +GY TEST: 3484 SUBJ: ADAM-S WT: 143.0 NOM G: 8.0 CELL: A

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
HARNES ANCHOR FORCES (LB)					
LEFT HORIZ X AXIS	-0.06	1.50	-0.06	17.	0.
LEFT HORIZ Y AXIS	16.62	235.65	-2.57	78.	347.
LEFT HORIZ Z AXIS	11.95	86.52	0.03	70.	335.
LEFT RESULTANT	20.49	251.03	0.84	78.	342.
RIGHT HORIZ X AXIS	-15.44	3.06	-18.81	51.	346.
RIGHT HORIZ Y AXIS	-12.28	22.68	-12.49	72.	1.
RIGHT HORIZ Z AXIS	13.88	15.11	1.65	1.	44.
RIGHT RESULTANT	24.14	25.18	8.86	346.	32.
LEFT VERT X AXIS	3.07	48.08	-1.80	120.	304.
LEFT VERT Y AXIS	-0.76	275.05	-60.56	52.	78.
LEFT VERT Z AXIS	-3.82	4.31	-178.53	324.	121.
LEFT RESULTANT	4.96	276.30	1.84	52.	317.
RIGHT VERT X AXIS	4.95	10.65	-1.99	106.	304.
RIGHT VERT Y AXIS	0.21	24.35	-1.52	73.	286.
RIGHT VERT Z AXIS	-9.00	0.77	-21.74	39.	113.
RIGHT RESULTANT	10.32	30.98	0.82	115.	271.
ADAM INTERNAL TEMP (DEG C)	122.33	124.60	122.10	77.	3.
ADAM ACCELERATIONS (G)					
HEAD Y AXIS	0.07	16.46	-2.18	140.	264.
HEAD Z AXIS	0.96	4.17	-14.40	71.	109.
CHEST Y AXIS	0.07	15.27	-1.19	88.	349.
LUMBAR Y AXIS	0.00	17.24	-0.97	68.	321.
ADAM FORCES (LB)					
NECK Y AXIS	3.98	12.58	-154.51	266.	139.
NECK Z AXIS	22.16	234.43	-22.37	127.	72.
LUMBAR Y AXIS	15.82	177.57	-90.82	125.	64.
ADAM NECK MX TORQUE (IN-LB)	3.67	437.72	-175.09	144.	78.

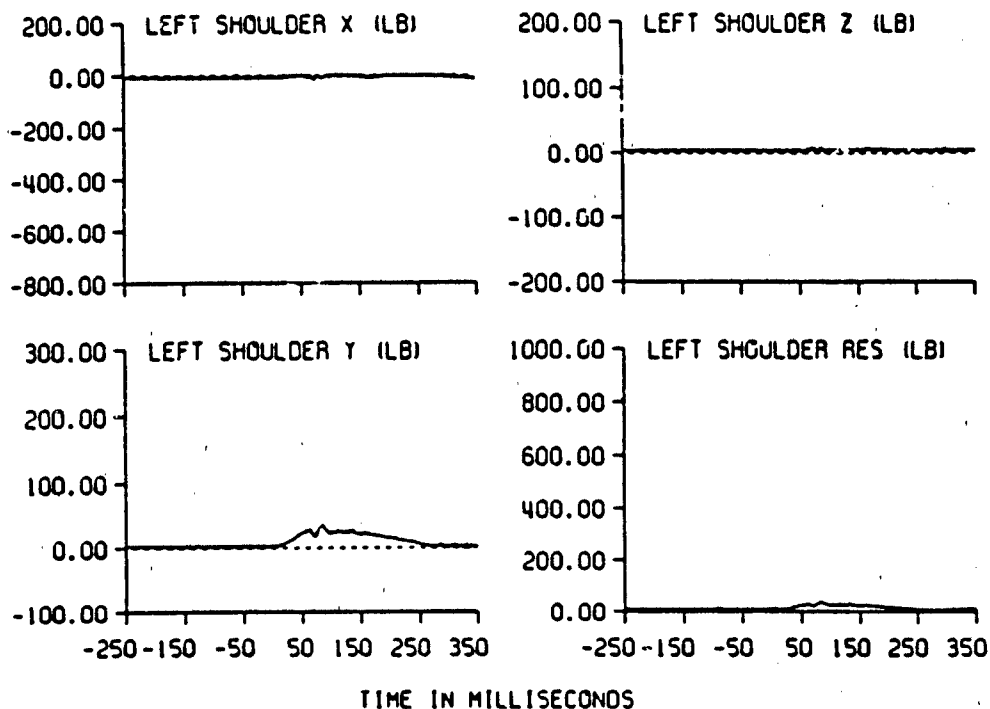
CHIA STUDY +GY TEST: 3484 SUBJ: ADAM-S CELL: A



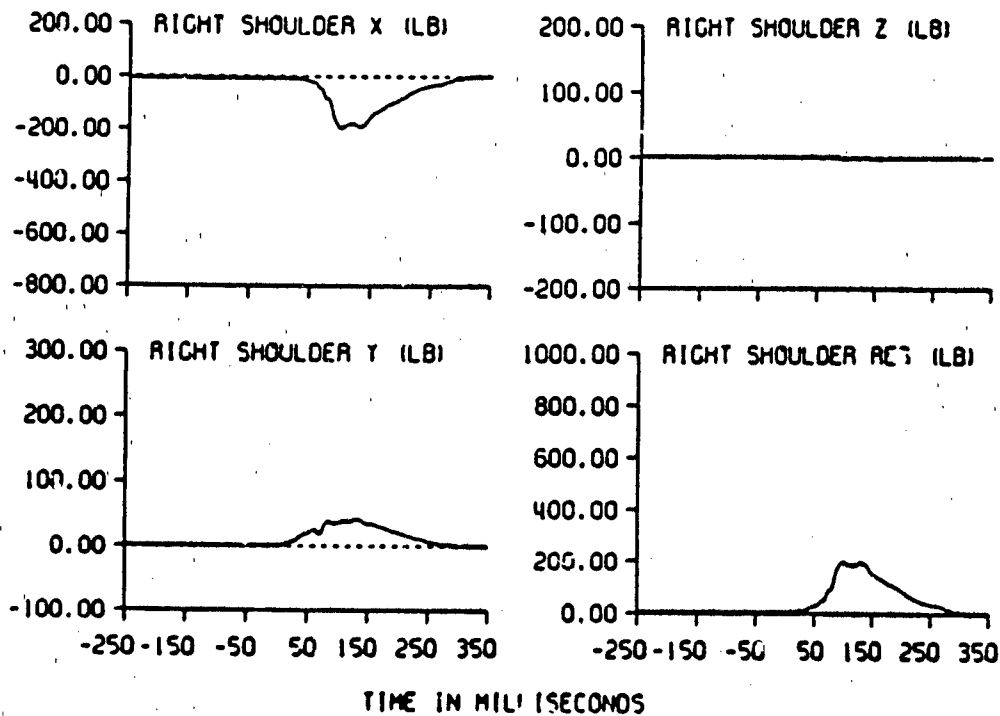
CHIA STUDY +GY TEST: 3484 SUBJ: ADAM-S CELL: A



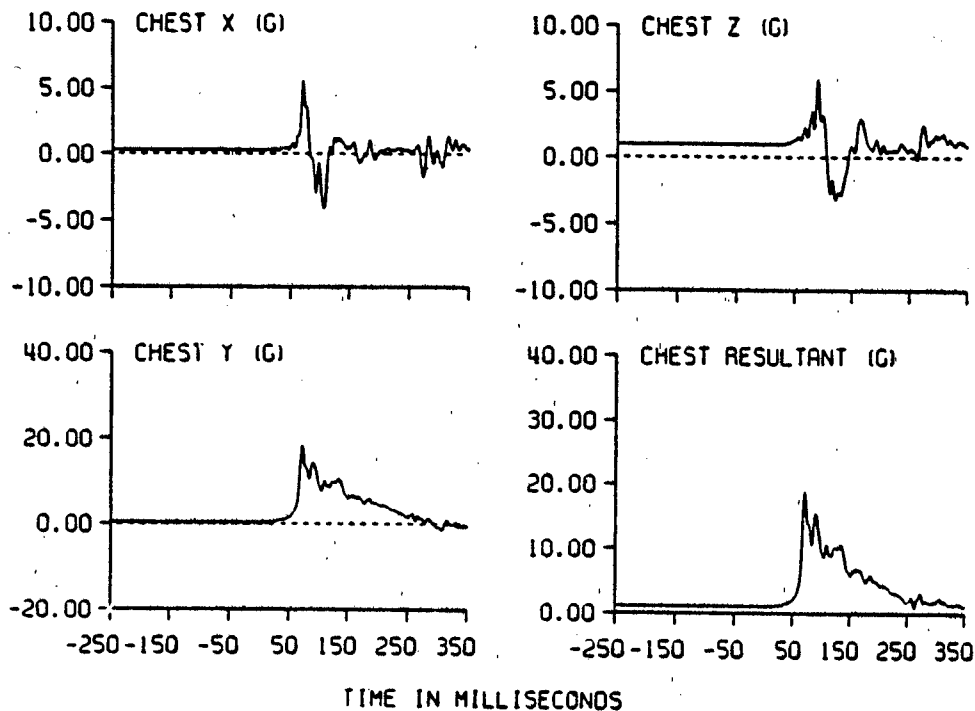
CHIA STUDY +GY TEST: 3484 SUBJ: ADAM-S CELL: A



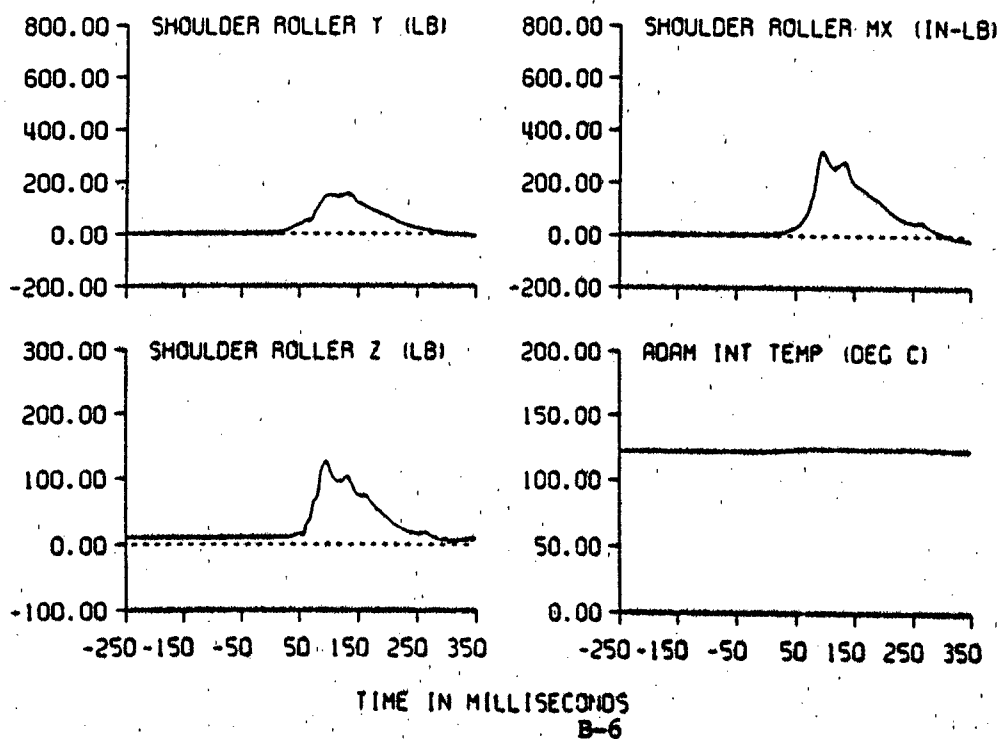
CHIA STUDY +GY TEST: 3484 SUBJ: ADAM-S CELL: A



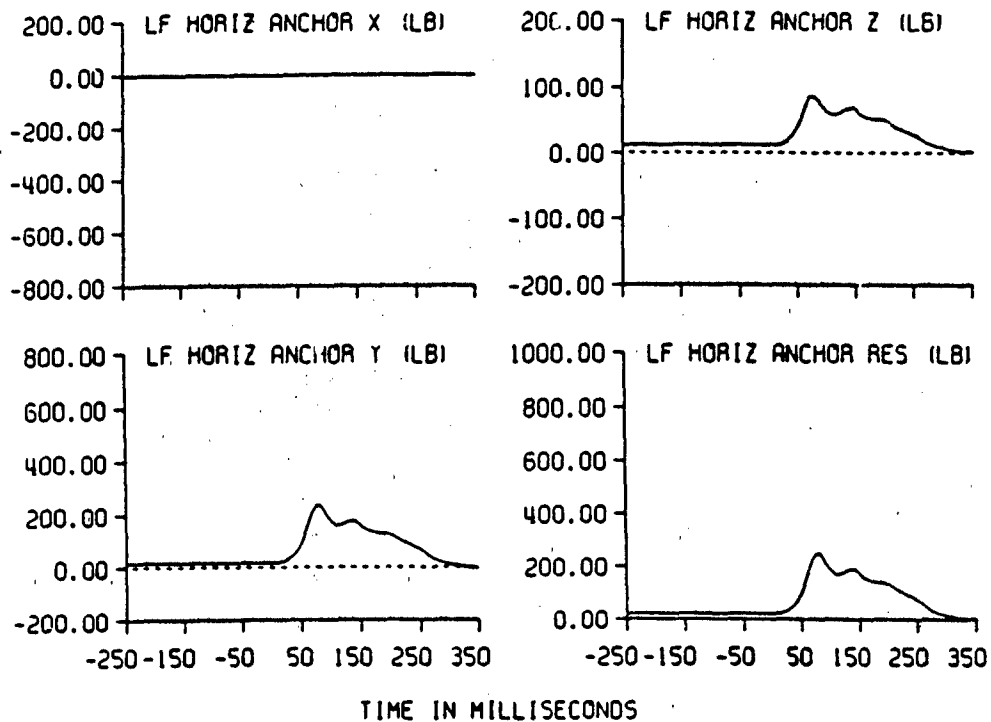
CHIA STUDY +GY TEST: 3484 SUBJ: ADAM-S CELL: A



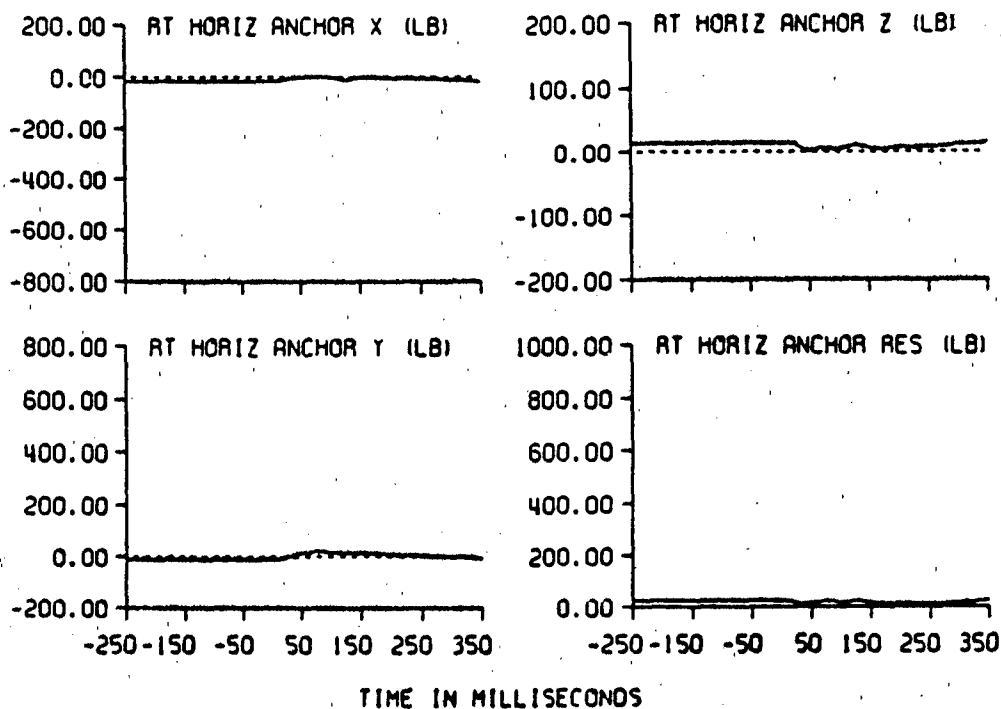
CHIA STUDY +GY TEST: 3484 SUBJ: ADAM-S CELL: A



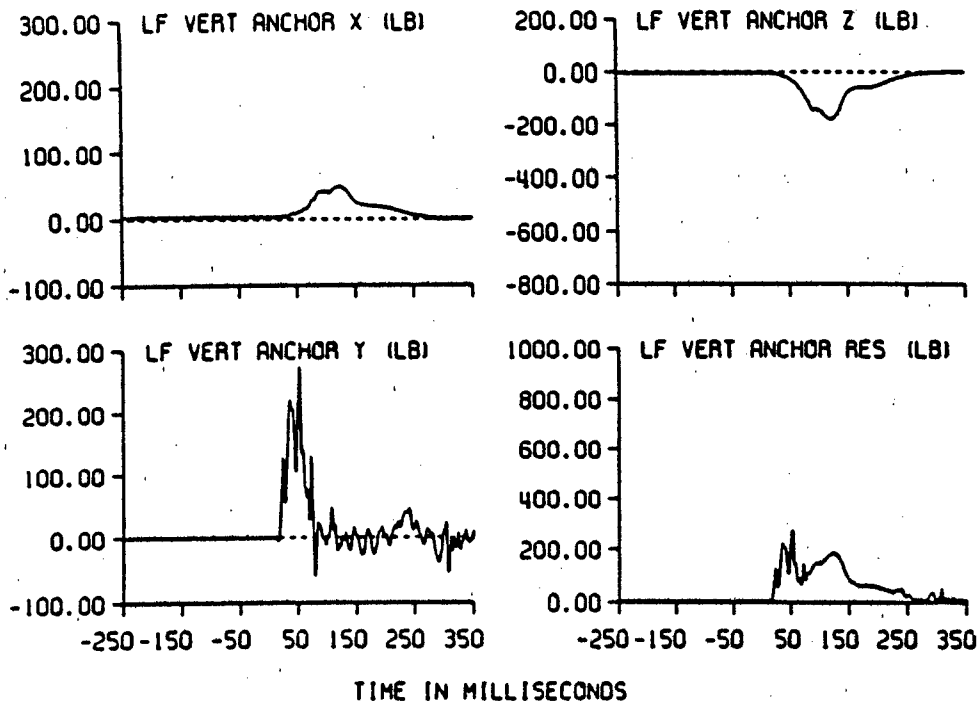
CHIA STUDY +GY TEST: 3484 SUBJ: ADAM-S CELL: A



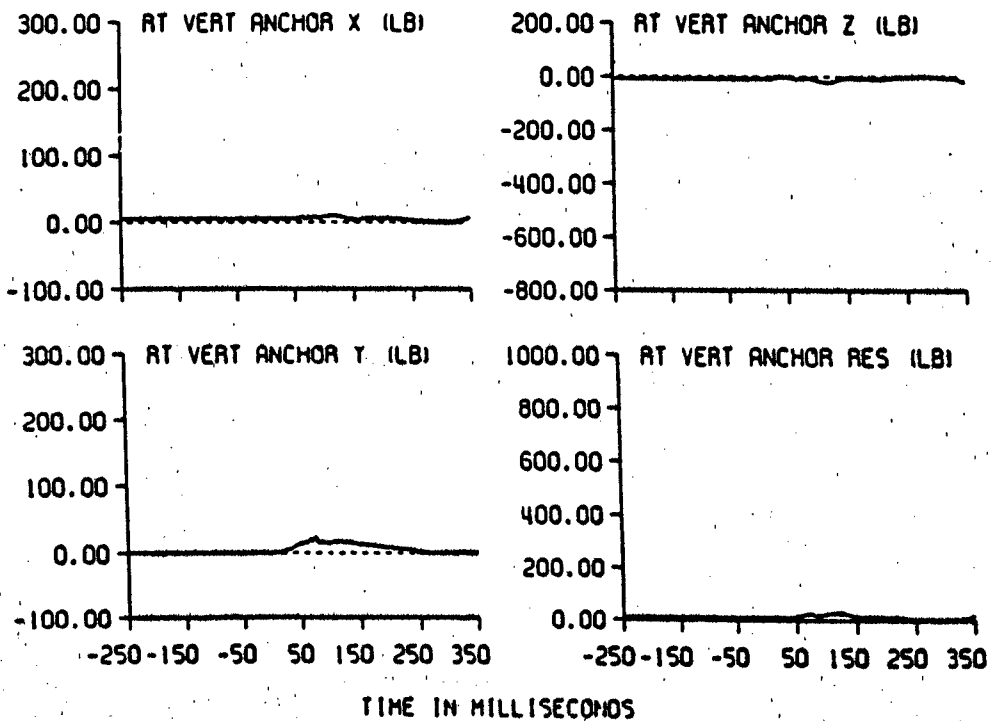
CHIA STUDY +GY TEST: 3484 SUBJ: ADAM-S CELL: A



CHIA STUDY +GY TEST: 3484 SUBJ: ADAM-S CELL: A

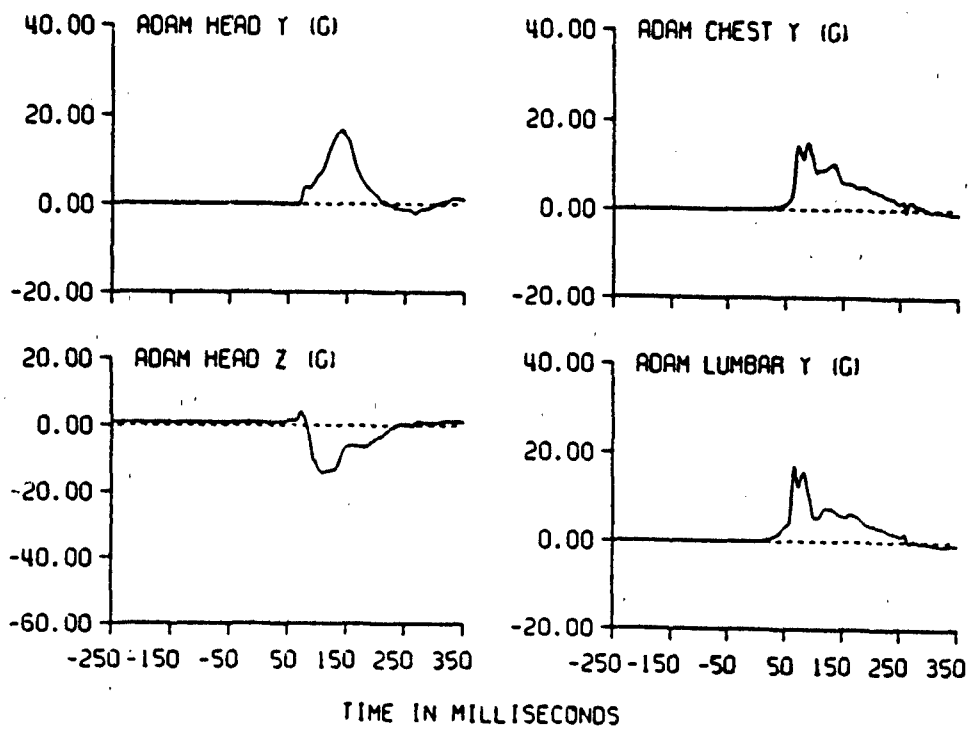


CHIA STUDY +GY TEST: 3484 SUBJ: ADAM-S CELL: A

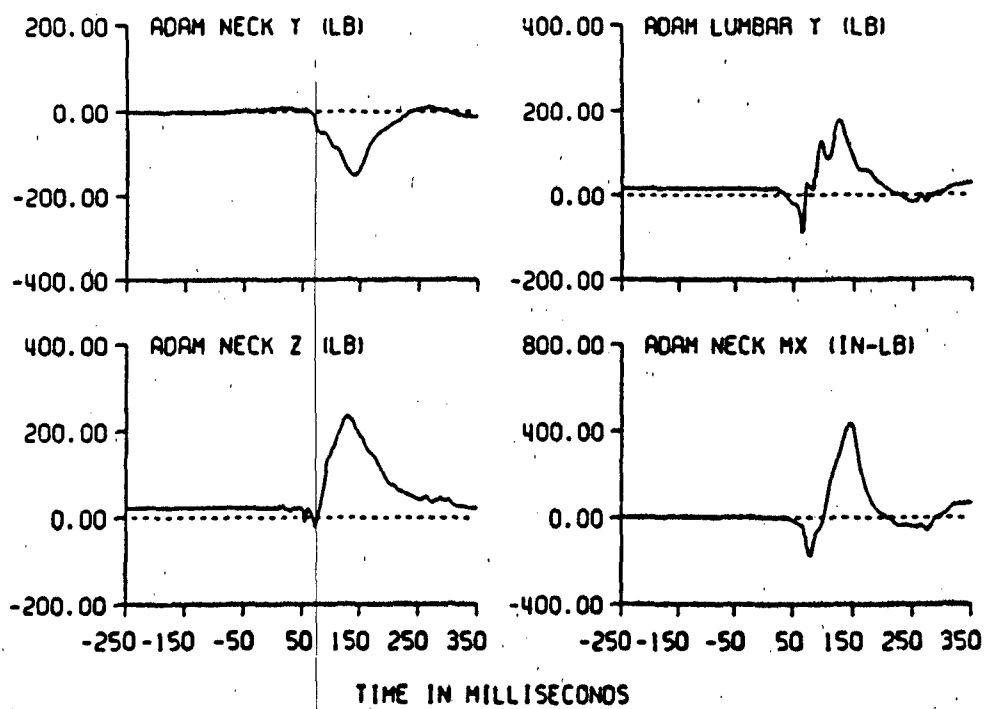




CHIA STUDY +GY TEST: 3484 SUBJ: ADAM-S CELL: A



CHIA STUDY +GY TEST: 3484 SUBJ: ADAM-S CELL: A



CHIA STUDY +GY TEST: 3485 SUBJ: ADAM-L WT: 216.0 NOM G: 8.0 CELL: A

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK TIME (MS)				-265.	
2.5V EXT POWER (VOLTS)	2.50	2.50	2.50	86.	265.
10V EXT POWER (VOLTS)	10.00	10.00	10.00	0.	9.
SLED ACCELERATION (G)					
X AXIS	-0.01	0.48	-1.21	70.	62.
Y AXIS	0.02	7.98	-0.44	69.	282.
Z AXIS	0.98	1.43	0.42	80.	60.
SEAT ACCELERATION (G)					
X AXIS	0.34	1.66	-1.80	69.	61.
Y AXIS	-0.02	12.60	-0.83	84.	298.
Z AXIS	0.94	2.53	-0.77	61.	55.
RESULTANT	1.00	12.67	0.68	84.	295.
CHEST ACCELERATION (G)					
X AXIS	0.21	7.21	-8.47	79.	97.
Y AXIS	0.21	20.41	-3.76	78.	273.
Z AXIS	0.97	6.47	-7.06	75.	112.
RESULTANT	1.02	22.21	0.52	78.	316.
RY (RAD/SEC2)	1.23	1803.02	-2392.55	86.	97.
SLED VELOCITY (PPS)	0.03	42.13	0.00	261.	3.
SHOULDER STRAP FORCES (LB)					
LEFT X AXIS	-8.31	5.97	-29.38	53.	173.
LEFT Y AXIS	4.65	49.50	2.30	91.	294.
LEFT Z AXIS	6.66	10.28	2.25	60.	55.
LEFT RESULTANT	11.64	53.66	5.43	91.	296.
RIGHT X AXIS	-10.55	1.38	-374.17	325.	101.
RIGHT Y AXIS	1.98	90.56	-0.58	91.	295.
RIGHT Z AXIS	1.33	4.85	-9.11	60.	103.
RIGHT RESULTANT	10.84	381.97	0.86	101.	340.
SHOULDER ROLLER					
Y AXIS FORCE (LB)	-0.49	279.38	-6.57	95.	331.
Z AXIS FORCE (LB)	8.89	148.73	-0.17	97.	296.
X AXIS TORQUE (IN-LB)	8.20	409.98	-8.09	96.	330.

CHIA STUDY +GY TEST: 3485 SUBJ: ADAM-L WT: 216.0 NOM G: 8.0 CELL: A

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
HARNES ANCHOR FORCES (LB)					
LEFT HORIZ X AXIS	-10.48	-1.47	-282.61	332.	104.
LEFT HORIZ Y AXIS	10.75	181.15	2.05	85.	333.
LEFT HORIZ Z AXIS	11.68	80.15	2.67	100.	327.
LEFT RESULTANT	19.03	336.30	3.67	103.	337.
RIGHT HORIZ X AXIS	-15.00	2.90	-29.90	73.	340.
RIGHT HORIZ Y AXIS	-11.07	54.27	-10.80	83.	1.
RIGHT HORIZ Z AXIS	17.15	21.80	-1.75	337.	79.
RIGHT RESULTANT	25.35	54.37	9.68	85.	31.
LEFT VERT X AXIS	2.54	33.19	0.34	94.	55.
LEFT VERT Y AXIS	-0.85	115.71	-3.79	98.	303.
LEFT VERT Z AXIS	-2.24	1.83	-335.40	313.	102.
LEFT RESULTANT	3.56	354.91	2.72	102.	2.
RIGHT VERT X AXIS	4.82	28.84	-0.04	107.	278.
RIGHT VERT Y AXIS	0.52	32.42	-2.07	84.	329.
RIGHT VERT Z AXIS	-7.66	1.87	-52.81	270.	108.
RIGHT RESULTANT	9.16	64.09	1.39	109.	278.
ADAM INTERNAL TEMP (DEG C)	114.39	114.50	112.50	0.	269.
ADAM ACCELERATIONS (G)					
HEAD Y AXIS	-0.01	15.94	-2.98	127.	49.
HEAD Z AXIS	1.01	2.80	-18.97	75.	105.
CHEST Y AXIS	0.03	18.49	-0.36	97.	269.
LUMBAR Y AXIS	0.08	22.46	-0.79	77.	333.
ADAM FORCES (LB)					
NECK Y AXIS	-0.58	20.43	-176.30	53.	130.
NECK Z AXIS	-7.02	192.75	-58.38	105.	53.
LUMBAR Y AXIS	2.41	262.98	-82.37	80.	69.
ADAM NECK MX TORQUE (IN-LB)					
	-1.40	561.02	-153.53	125.	80.

CHIA STUDY +GY TEST: 3486 SUBJ: ADAM-L WT: 216.0 NOM G: 11.0 CELL: B

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK TIME (MS)				-244.	
2.5V EXT POWER (VOLTS)	2.50	2.50	2.50	1.	46.
10V EXT POWER (VOLTS)	10.00	10.00	10.00	0.	1.
SLED ACCELERATION (G)					
X AXIS	-0.03	0.54	-1.51	341.	56.
Y AXIS	0.00	11.27	-0.64	100.	235.
Z AXIS	0.96	1.73	-0.07	234.	54.
SEAT ACCELERATION (G)					
X AXIS	0.21	2.48	-2.47	65.	53.
Y AXIS	-0.02	17.80	-1.34	77.	253.
Z AXIS	0.92	2.84	-1.37	55.	50.
RESULTANT	0.94	18.04	0.59	77.	357.
CHEST ACCELERATION (G)					
X AXIS	0.19	9.97	-20.00	78.	92.
Y AXIS	0.19	31.66	-3.57	74.	347.
Z AXIS	1.00	6.46	-8.82	71.	106.
RESULTANT	1.04	35.30	0.37	92.	256.
RY (RAD/SEC2)	-8.61	2481.57	-2871.79	83.	92.
SLED VELOCITY (FPS)	0.01	52.05	0.01	241.	0.
SHOULDER STRAP FORCES (LB)					
LEFT X AXIS	-9.58	6.21	-64.50	48.	146.
LEFT Y AXIS	2.91	68.66	-0.41	86.	248.
LEFT Z AXIS	5.22	12.94	-0.83	77.	50.
LEFT RESULTANT	11.31	76.30	4.22	84.	239.
RIGHT X AXIS	-9.29	4.55	-481.70	355.	95.
RIGHT Y AXIS	1.14	129.63	-1.24	88.	286.
RIGHT Z AXIS	0.72	4.72	-14.31	55.	92.
RIGHT RESULTANT	9.41	494.00	0.69	95.	295.
SHOULDER ROLLER					
Y AXIS FORCE (LB)	-1.27	389.54	-15.42	91.	333.
Z AXIS FORCE (LB)	6.07	150.74	-2.81	77.	346.
X AXIS TORQUE (IN-LB)	2.62	458.95	-19.24	90.	312.

CHIA STUDY +GY TEST: 3486 SUBJ: ADAM-L WT: 216.0 NOM G: 11.0 CELL: B

DATA ID	IMMEDIATE PRBIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
HARNES ANCHOR FORCES (LB)					
LEFT HORIZ X AXIS	-11.53	0.06	-413.85	354.	98.
LEFT HORIZ Y AXIS	2.23	246.74	-1.91	76.	311.
LEFT HORIZ Z AXIS	9.56	97.23	-0.07	96.	357.
LEFT RESULTANT	15.19	479.77	1.51	98.	357.
RIGHT HORIZ X AXIS	-12.43	9.37	-62.48	61.	357.
RIGHT HORIZ Y AXIS	-12.59	71.89	-19.55	76.	336.
RIGHT HORIZ Z AXIS	13.18	38.29	-12.18	348.	64.
RIGHT RESULTANT	22.07	75.41	7.79	358.	24.
LEFT VERT X AXIS	1.17	43.89	-2.34	83.	52.
LEFT VERT Y AXIS	1.86	188.20	-2.49	97.	289.
LEFT VERT Z AXIS	-2.73	2.19	-487.40	329.	99.
LEFT RESULTANT	3.61	523.30	2.29	99.	278.
RIGHT VERT X AXIS	1.81	39.77	-3.54	100.	280.
RIGHT VERT Y AXIS	-0.38	42.73	-3.83	81.	348.
RIGHT VERT Z AXIS	-6.19	0.00	-128.65	35.	101.
RIGHT RESULTANT	6.47	140.76	0.39	101.	243.
ADAM INTERNAL TEMP (DEG C)	108.81	109.00	108.00	0.	28.
ADAM ACCELERATIONS (G)					
HEAD Y AXIS	-0.04	22.73	-2.26	127.	353.
HEAD Z AXIS	1.06	4.18	-33.30	71.	99.
CHEST Y AXIS	0.11	26.30	-2.63	89.	345.
LUMBAR Y AXIS	0.15	34.88	-2.06	72.	336.
ADAM FORCES (LB)					
NECK Y AXIS	-0.25	29.71	-255.14	355.	123.
NECK Z AXIS	8.66	369.83	-19.90	100.	50.
LUMBAR Y AXIS	-5.09	378.91	-173.67	78.	66.
ADAM NECK MX TORQUE (IN-LB)	-4.14	768.99	-296.99	117.	76.

CHIA STUDY +GY TEST: 3487 SUBJ: ADAM-L WT: 216.0 MOM G: 14.0 CELL: C

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK TIME (MS)				-263.	
2.5V EXT POWER (VOLTS)	2.50	2.50	2.50	175.	96.
10V EXT POWER (VOLTS)	10.00	10.00	10.00	19.	33.
SLED ACCELERATION (G)					
X AXIS	-0.02	0.79	-1.81	58.	51.
Y AXIS	0.03	14.35	-0.60	90.	213.
Z AXIS	0.99	1.57	0.05	209.	60.
SEAT ACCELERATION (G)					
X AXIS	0.23	3.54	-2.37	60.	50.
Y AXIS	0.01	24.88	-1.61	67.	307.
Z AXIS	0.94	4.31	-2.41	67.	62.
RESULTANT	0.97	25.27	0.77	67.	301.
CHEST ACCELERATION (G)					
X AXIS	0.23	10.32	-23.37	71.	82.
Y AXIS	0.16	36.68	-4.38	68.	319.
Z AXIS	1.06	8.70	-12.48	86.	100.
RESULTANT	1.10	40.98	0.80	80.	238.
RY (RAD/SEC <sup>2</sup> )	-7.16	3489.89	-4179.06	96.	88.
SLED VELOCITY (FPS)	0.02	59.94	0.03	219.	0.
SHOULDER STRAP FORCES (LB)					
LEFT X AXIS	-8.63	5.34	-83.04	44.	124.
LEFT Y AXIS	1.17	85.16	-4.63	76.	306.
LEFT Z AXIS	3.03	14.64	-4.86	68.	62.
LEFT RESULTANT	9.24	105.03	3.21	77.	215.
RIGHT X AXIS	-7.63	4.15	-470.23	315.	86.
RIGHT Y AXIS	0.99	143.28	-2.78	77.	304.
RIGHT Z AXIS	0.59	3.17	-20.93	50.	88.
RIGHT RESULTANT	7.75	483.36	0.80	86.	278.
SHOULDER ROLLER					
Y AXIS FORCE (LB)	-2.66	432.48	-20.43	80.	311.
Z AXIS FORCE (LB)	4.26	128.39	-1.90	74.	228.
X AXIS TORQUE (IN-LB)	-1.55	413.37	-29.29	86.	284.

CHIA STUDY +GY TEST: 3487 SUBJ: ADAM-L WT: 216.0 NOM G: 14.0 CELL: C

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
<b>HARNES ANCHOR FORCES (LB)</b>					
LEFT HORIZ X AXIS	-9.89	0.69	-411.66	285.	91.
LEFT HORIZ Y AXIS	7.32	234.78	-3.44	68.	306.
LEFT HORIZ Z AXIS	9.29	95.57	-1.73	85.	319.
LEFT RESULTANT	15.44	471.38	0.69	89.	285.
RIGHT HORIZ X AXIS	-15.56	7.81	-79.66	56.	320.
RIGHT HORIZ Y AXIS	-11.48	93.69	-38.20	67.	314.
RIGHT HORIZ Z AXIS	17.80	53.06	-0.77	318.	56.
RIGHT RESULTANT	26.29	102.41	13.51	320.	23.
LEFT VERT X AXIS	0.14	39.03	0.10	70.	0.
LEFT VERT Y AXIS	-0.02	265.82	-4.96	85.	311.
LEFT VERT Z AXIS	-0.93	4.23	-692.58	296.	93.
LEFT RESULTANT	1.24	738.59	0.23	94.	0.
RIGHT VERT X AXIS	0.54	52.94	-3.00	93.	278.
RIGHT VERT Y AXIS	0.76	55.87	-6.21	92.	337.
RIGHT VERT Z AXIS	-3.29	3.02	-186.73	259.	95.
RIGHT RESULTANT	3.46	200.59	0.94	95.	1.
<b>ADAM INTERNAL TEMP (DEG C)</b>	108.62	109.00	107.25	102.	70.
<b>ADAM ACCELERATIONS (G)</b>					
HEAD Y AXIS	-0.06	27.57	-4.04	117.	222.
HEAD Z AXIS	1.02	5.47	-48.34	64.	91.
CHEST Y AXIS	-0.07	29.59	-4.10	80.	297.
LUMBAR Y AXIS	0.09	45.20	-3.59	63.	304.
<b>ADAM FORCES (LB)</b>					
NECK Y AXIS	2.94	40.95	-332.04	215.	116.
NECK Z AXIS	-3.54	518.72	-39.80	92.	64.
LUMBAR Y AXIS	-0.32	508.84	-320.02	87.	59.
<b>ADAM NECK MX TORQUE (IN-LB)</b>	-8.01	965.16	-413.20	120.	70.

CHIA STUDY +GY TEST: 3489 SUBJ: ADAM-L WT: 216.0 NOM G: 11.0 CELL: E

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK TIME (MS)				-284.	
2.5V EXT POWER (VOLTS)	2.50	2.50	2.49	219.	300.
10V EXT POWER (VOLTS)	10.00	10.00	10.00	2.	46.
SLED ACCELERATION (G)					
X AXIS	-0.02	0.28	-1.45	65.	58.
Y AXIS	0.01	11.07	-0.59	98.	237.
Z AXIS	0.98	1.72	0.24	82.	63.
SEAT ACCELERATION (G)					
X AXIS	0.23	2.12	-2.58	101.	58.
Y AXIS	-0.01	15.04	-0.72	85.	240.
Z AXIS	0.94	2.03	-1.42	60.	65.
RESULTANT	0.97	15.09	0.54	85.	269.
CHEST ACCELERATION (G)					
X AXIS	0.14	12.18	-13.28	79.	94.
Y AXIS	0.18	35.21	-3.24	78.	221.
Z AXIS	1.04	11.50	-9.34	78.	107.
RESULTANT	1.07	38.81	0.96	78.	16.
RY (RAD/SEC2)	-6.38	2950.27	-3427.14	86.	96.
SLED VELOCITY (FPS)	0.01	51.93	0.02	234.	0.
SHOULDER STRAP FORCES (LB)					
LEFT X AXIS	-8.16	3.85	-70.79	66.	144.
LEFT Y AXIS	3.45	55.30	0.05	88.	320.
LEFT Z AXIS	4.93	11.81	1.49	143.	65.
LEFT RESULTANT	10.15	79.66	8.50	144.	3.
RIGHT X AXIS	-7.42	0.71	-564.60	296.	86.
RIGHT Y AXIS	1.68	136.60	-1.29	87.	277.
RIGHT Z AXIS	1.15	3.78	-13.98	60.	90.
RIGHT RESULTANT	7.72	580.68	0.72	86.	298.
SHOULDER ROLLER					
Y AXIS FORCE (LB)	-1.82	479.23	-10.98	86.	277.
Z AXIS FORCE (LB)	7.79	328.24	1.60	84.	320.
X AXIS TORQUE (IN-LB)	4.76	898.50	-19.62	85.	284.



CHIA STUDY +GY TEST: 3489 SUBJ: ADAM-L WT: 216.0 NOM G: 11.0 CELL: E

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
<b>HARNES ANCHOR FORCES (LB)</b>					
LEFT HORIZ X AXIS	-17.35	3.31	-116.96	275.	93.
LEFT HORIZ Y AXIS	-2.17	86.18	-16.42	82.	307.
LEFT HORIZ Z AXIS	0.63	3.67	-43.17	284.	91.
LEFT RESULTANT	17.53	141.43	0.79	92.	253.
RIGHT HORIZ X AXIS	-15.65	9.34	-148.41	199.	97.
RIGHT HORIZ Y AXIS	2.71	219.01	-4.33	64.	305.
RIGHT HORIZ Z AXIS	1.65	11.74	-67.33	71.	104.
RIGHT RESULTANT	15.97	258.63	3.72	64.	259.
LEFT VERT X AXIS	-0.28	1.27	-54.69	292.	89.
LEFT VERT Y AXIS	0.00	167.86	-2.49	92.	305.
LEFT VERT Z AXIS	-0.60	1.75	-583.33	277.	93.
LEFT RESULTANT	0.89	609.35	0.29	93.	1.
RIGHT VERT X AXIS	-1.23	0.43	-8.59	24.	57.
RIGHT VERT Y AXIS	0.17	29.35	-1.69	56.	236.
RIGHT VERT Z AXIS	-0.52	2.57	-19.94	222.	104.
RIGHT RESULTANT	1.59	34.43	0.78	104.	253.
<b>ADAM INTERNAL TEMP (DEG C)</b>	105.48	106.00	104.75	54.	77.
<b>ADAM ACCELERATIONS (G)</b>					
HEAD Y AXIS	-0.13	20.95	-2.94	122.	60.
HEAD Z AXIS	1.02	2.35	-34.93	312.	97.
CHEST Y AXIS	-0.03	27.27	-2.21	78.	319.
LUMBAR Y AXIS	0.10	23.03	-1.53	63.	302.
<b>ADAM FORCES (LB)</b>					
NECK Y AXIS	1.87	35.16	-251.27	60.	120.
NECK Z AXIS	-2.16	340.38	-12.30	96.	50.
LUMBAR Y AXIS	-3.27	50.24	-531.93	106.	67.
<b>ADAM NECK MX TORQUE (IN-LB)</b>	-6.60	714.72	-308.31	125.	76.

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CHIA STUDY +GY TEST: 3490 SUBJ: ADAM-L WT: 216.0 NOM G: 14.0 CELL: F

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK TIME (MS)				-276.	
2.5V EXT POWER (VOLTS)	2.50	2.50	2.50	4.	12.
10V EXT POWER (VOLTS)	10.00	10.00	10.00	74.	4.
SLED ACCELERATION (G)					
X AXIS	-0.02	0.49	-1.81	61.	53.
Y AXIS	0.03	14.54	-0.56	89.	213.
Z AXIS	1.01	2.34	-0.24	71.	62.
SEAT ACCELERATION (G)					
X AXIS	0.27	3.24	-3.54	85.	54.
Y AXIS	-0.01	24.02	-1.66	66.	298.
Z AXIS	0.90	2.99	-3.25	68.	63.
RESULTANT	0.94	24.08	0.59	66.	208.
CHEST ACCELERATION (G)					
X AXIS	0.25	7.67	-10.50	67.	80.
Y AXIS	0.38	32.09	-4.14	84.	310.
Z AXIS	1.23	7.76	-10.01	76.	102.
RESULTANT	1.31	33.10	0.62	84.	225.
RY (RAD/SEC2)	-11.25	2397.66	-1755.87	72.	81.
SLED VELOCITY (FPS)	0.04	59.80	0.08	213.	0.
SHOULDER STRAP FORCES (LB)					
LEFT X AXIS	-8.88	4.87	-87.44	62.	131.
LEFT Y AXIS	1.65	70.41	-5.57	74.	295.
LEFT Z AXIS	4.14	13.72	-3.49	129.	63.
LEFT RESULTANT	9.97	97.66	9.82	131.	7.
RIGHT X AXIS	-10.10	4.27	-598.59	296.	88.
RIGHT Y AXIS	2.00	140.24	-4.65	76.	295.
RIGHT Z AXIS	0.37	2.56	-15.20	57.	63.
RIGHT RESULTANT	10.33	612.43	0.32	89.	267.
SHOULDER ROLLER					
Y AXIS FORCE (LB)	0.00	477.78	-23.09	104.	294.
Z AXIS FORCE (LB)	11.11	294.05	6.50	82.	259.
X AXIS TORQUE (IN-LB)	7.20	837.67	-39.46	85.	284.

CHIA STUDY +GY TRST: 3490 SUBJ: ADAM-L WT: 216.0 NOM G: 14.0 CELL: F

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
HARNESSE ANCHOR FORCES (LB)					
LEFT HORIZ X AXIS	-15.88	20.65	-162.10	309.	82.
LEFT HORIZ Y AXIS	-9.43	118.24	-48.69	69.	302.
LEFT HORIZ Z AXIS	-3.21	2.20	-59.06	251.	77.
LEFT RESULTANT	18.77	200.08	3.12	85.	235.
RIGHT HORIZ X AXIS	-14.14	15.71	-335.72	215.	60.
RIGHT HORIZ Y AXIS	5.73	323.15	-12.73	61.	292.
RIGHT HORIZ Z AXIS	-1.44	2.12	-145.93	259.	96.
RIGHT RESULTANT	15.36	462.81	13.24	61.	237.
LEFT VERT X AXIS	-0.80	1.63	-68.93	288.	97.
LEFT VERT Y AXIS	-0.07	216.09	-2.57	86.	258.
LEFT VERT Z AXIS	-1.09	2.03	-731.34	244.	85.
LEFT RESULTANT	1.57	764.78	0.41	85.	242.
RIGHT VERT X AXIS	0.21	1.05	-20.61	1.	95.
RIGHT VERT Y AXIS	0.07	56.97	-1.66	103.	222.
RIGHT VERT Z AXIS	-0.46	2.51	-106.84	236.	99.
RIGHT RESULTANT	1.28	119.95	1.04	99.	0.
ADAM INTERNAL TEMP (DEG C)	102.69	103.26	101.76	47.	66.
ADAM ACCELERATIONS (G)					
HEAD Y AXIS	0.09	24.15	-2.50	118.	224.
HEAD Z AXIS	0.99	5.52	-39.42	292.	91.
CHEST Y AXIS	0.18	28.56	-2.56	79.	287.
LUMBAR Y AXIS	0.10	36.20	-3.14	61.	291.
ADAM FORCES (LB)					
NECK Y AXIS	-2.13	25.59	-287.59	224.	116.
NECK Z AXIS	-3.07	400.49	-42.76	91.	292.
LUMBAR Y AXIS	8.19	236.66	-365.25	101.	59.
ADAM NECK MX TORQUE (IN-LB)	0.36	800.07	-250.29	113.	67.

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CHIA STUDY +GY TEST: 3491 SUBJ: ADAM-S WT: 143.0 NOM G: 8.0 CELL: D

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK TIME (MS)				-328.	
2.5V EXT POWER (VOLTS)	2.50	2.50	2.50	33.	71.
10V EXT POWER (VOLTS)	10.00	10.00	10.00	154.	0.
SLED ACCELERATION (G)					
X AXIS	0.00	0.22	-1.10	54.	64.
Y AXIS	0.03	8.11	-0.46	95.	279.
Z AXIS	1.03	1.70	0.17	79.	84.
SEAT ACCELERATION (G)					
X AXIS	0.26	2.54	-2.29	98.	64.
Y AXIS	-0.03	13.13	-0.41	83.	265.
Z AXIS	0.92	3.02	-0.79	93.	50.
RESULTANT	0.95	13.17	0.70	83.	274.
CHEST ACCELERATION (G)					
X AXIS	0.19	6.72	-3.22	65.	107.
Y AXIS	0.35	22.10	0.15	67.	277.
Z AXIS	1.17	3.22	-1.59	183.	117.
RESULTANT	1.24	22.91	1.15	66.	4.
RY (RAL/SEC2)	-11.55	823.22	-686.12	72.	222.
SLED VELOCITY (FPS)	0.00	41.99	-0.01	259.	1.
SHOULDER STRAP FORCES (LB)					
LEFT X AXIS	-3.15	8.56	-15.01	100.	66.
LEFT Y AXIS	6.56	40.61	6.08	81.	3.
LEFT Z AXIS	7.71	12.43	3.26	81.	51.
LEFT RESULTANT	10.62	42.79	9.07	81.	260.
RIGHT X AXIS	-3.12	0.00	-256.96	273.	95.
RIGHT Y AXIS	1.13	55.20	0.28	88.	270.
RIGHT Z AXIS	1.87	5.58	-2.03	81.	51.
RIGHT RESULTANT	3.90	260.24	1.54	95.	273.
SHOULDER ROLLER					
Y AXIS FORCE (LB)	-1.29	209.87	-3.27	90.	274.
Z AXIS FORCE (LB)	4.56	171.06	-3.89	93.	276.
X AXIS TORQUE (IN-LB)	1.42	460.59	-1.20	95.	275.

CHIA STUDY +GY TEST: 3491 SUBJ: ADAM-S WT: 143.0 NOM G: 8.0 CELL: D

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
HARNES ANCHOR FORCES (LB)					
LEFT HORIZ X AXIS	-1.37	0.37	-118.33	13.	84.
LEFT HORIZ Y AXIS	-1.46	162.86	-0.59	80.	0.
LEFT HORIZ Z AXIS	1.30	3.24	-38.20	5.	86.
LEFT RESULTANT	2.56	200.23	1.69	80.	10.
RIGHT HORIZ X AXIS	-6.22	15.65	-32.77	58.	79.
RIGHT HORIZ Y AXIS	-0.17	151.13	-0.11	77.	0.
RIGHT HORIZ Z AXIS	-0.81	-0.10	-57.30	0.	80.
RIGHT RESULTANT	6.33	162.09	4.66	77.	4.
LEFT VERT X AXIS	-2.99	-1.78	-26.11	276.	88.
LEFT VERT Y AXIS	-0.03	115.66	-0.03	78.	0.
LEFT VERT Z AXIS	-6.30	-6.30	-308.99	0.	89.
LEFT RESULTANT	6.97	326.34	6.97	89.	0.
RIGHT VERT X AXIS	-2.20	-0.33	-9.35	20.	110.
RIGHT VERT Y AXIS	0.38	33.14	-1.35	80.	4.
RIGHT VERT Z AXIS	-5.20	-1.61	-33.77	12.	73.
RIGHT RESULTANT	5.68	45.70	3.40	80.	12.
ADAM INTERNAL TEMP (DEG C)	118.70	119.85	118.11	129.	54.
ADAM ACCELERATIONS (G)					
HEAD Y AXIS	0.06	14.59	-0.98	129.	263.
HEAD Z AXIS	0.91	4.15	-14.42	66.	92.
CHEST Y AXIS	0.29	17.39	0.32	79.	0.
LUMBAR Y AXIS	-0.15	23.13	-0.31	73.	271.
ADAM FORCES (LB)					
NECK Y AXIS	-4.76	-2.13	-121.85	51.	130.
NECK Z AXIS	-27.44	133.51	-64.35	93.	51.
LUMBAR Y AXIS	5.84	341.33	-1713.05	84.	69.
ADAM NECK MX TORQUE (IN-LB)	43.42	311.26	-102.59	136.	70.

CHIA STUDY +GY TEST: 3492 SUBJ: ADAM-S WT: 143.0 NOM G: 11.0 CELL: B

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK TIME (MS)				-319.	
2.5V EXT POWER (VOLTS)	2.50	2.50	2.50	66.	2.
10V EXT POWER (VOLTS)	10.00	10.00	10.00	258.	56.
SLED ACCELERATION (G)					
X AXIS	0.00	0.28	-1.19	68.	61.
Y AXIS	0.02	11.11	-0.51	83.	236.
Z AXIS	0.98	1.46	0.03	72.	89.
SEAT ACCELERATION (G)					
X AXIS	0.24	2.23	-2.28	87.	62.
Y AXIS	-0.01	17.25	-0.74	66.	240.
Z AXIS	0.95	3.35	-1.23	83.	101.
RESULTANT	0.98	17.30	0.71	66.	252.
CHEST ACCELERATION (G)					
X AXIS	0.19	6.85	-5.72	79.	91.
Y AXIS	0.11	25.94	-0.92	81.	286.
Z AXIS	1.00	9.97	-6.39	72.	106.
RESULTANT	1.02	26.53	0.76	80.	278.
RY (RAD/SEC2)	-2.44	1631.38	-2231.75	107.	102.
SLED VELOCITY (FPS)	0.01	51.35	0.00	231.	1.
SHOULDER STRAP FORCES (LB)					
LEFT X AXIS	1.07	9.23	-33.98	73.	127.
LEFT Y AXIS	3.35	47.45	0.25	70.	230.
LEFT Z AXIS	3.66	9.66	-0.67	82.	89.
LEFT RESULTANT	5.15	51.68	3.40	127.	231.
RIGHT X AXIS	-0.35	3.68	-318.51	244.	117.
RIGHT Y AXIS	0.12	62.09	-2.17	119.	286.
RIGHT Z AXIS	1.15	2.61	-5.00	61.	88.
RIGHT RESULTANT	1.28	324.53	0.33	119.	3.
SHOULDER ROLLER					
Y AXIS FORCE (LB)	0.14	280.63	-3.55	119.	256.
Z AXIS FORCE (LB)	0.92	220.33	-1.15	120.	243.
X AXIS TORQUE (IN-LB)	1.84	516.38	-2.79	118.	272.

CHIA STUDY +GY TEST: 3492 SUBJ: ADAM-S WT: 143.0 NOM G: 11.0 CELL: E

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
<b>HARNESSE ANCHOR FORCES (LB)</b>					
LEFT HORIZ X AXIS	-1.99	3.65	-177.53	272.	124.
LEFT HORIZ Y AXIS	-1.81	156.50	-3.48	122.	275.
LEFT HORIZ Z AXIS	-0.37	1.98	-55.68	288.	120.
LEFT RESULTANT	2.91	241.98	1.05	122.	5.
RIGHT HORIZ X AXIS	-0.63	21.83	-42.20	51.	64.
RIGHT HORIZ Y AXIS	1.86	430.88	0.03	58.	272.
RIGHT HORIZ Z AXIS	-0.92	-1.11	-194.58	0.	54.
RIGHT RESULTANT	2.39	457.29	2.11	58.	1.
LEFT VERT X AXIS	0.02	6.01	-12.24	71.	111.
LEFT VERT Y AXIS	0.24	153.67	-1.42	110.	260.
LEFT VERT Z AXIS	-1.70	1.58	-416.91	267.	116.
LEFT RESULTANT	1.90	443.06	0.48	116.	0.
RIGHT VERT X AXIS	-0.87	3.65	-3.57	73.	287.
RIGHT VERT Y AXIS	1.14	33.97	-0.52	66.	234.
RIGHT VERT Z AXIS	-2.16	0.19	-22.32	16.	110.
RIGHT RESULTANT	2.98	35.26	0.55	66.	234.
ADAM INTERNAL TEMP (DEG C)	127.97	129.60	127.85	252.	0.
<b>ADAM ACCELERATIONS (G)</b>					
HEAD Y AXIS	-0.05	24.92	-2.73	125.	225.
HEAD Z AXIS	0.96	2.35	-24.32	61.	90.
CHEST Y AXIS	0.04	24.80	-0.60	78.	277.
LUMBAR Y AXIS	-0.11	36.22	-1.75	60.	290.
<b>ADAM FORCES (LB)</b>					
NECK Y AXIS	-4.02	9.18	-193.43	238.	125.
NECK Z AXIS	3.76	371.36	-6.12	123.	60.
LUMBAR Y AXIS	-5.53	612.17	-2182.26	112.	59.
ADAM NECK MX TORQUE (IN-LB)	-23.73	604.69	-290.65	128.	72.

CHIA STUDY +GY TEST: 3493 SUBJ: ADAM-S WT: 143.0 NOM G: 14.0 CELL: F

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK TIME (MS)				-286.	
2.5V EXT POWER (VOLTS)	2.50	2.51	2.50	166.	133.
10V EXT POWER (VOLTS)	10.00	10.00	10.00	211.	144.
SLED ACCELERATION (G)					
X AXIS	-0.03	0.32	-1.38	78.	57.
Y AXIS	0.01	14.21	-0.55	77.	214.
Z AXIS	0.96	1.48	0.02	211.	84.
SEAT ACCELERATION (G)					
X AXIS	0.24	2.46	-2.20	80.	58.
Y AXIS	-0.05	21.83	-1.39	61.	221.
Z AXIS	0.90	3.95	-0.87	76.	84.
RESULTANT	0.94	21.92	0.35	61.	209.
CHEST ACCELERATION (G)					
X AXIS	0.42	8.81	-11.22	54.	75.
Y AXIS	0.29	28.92	-2.25	73.	284.
Z AXIS	0.93	10.66	-9.18	76.	102.
RESULTANT	1.06	32.01	0.70	74.	257.
RY (RAD/SEC2)	-12.60	1835.20	-1962.98	69.	75.
SLED VELOCITY (FPS)	-0.01	59.72	0.00	219.	1.
SHOULDER STRAP FORCES (LB)					
LEFT X AXIS	1.70	5.85	-49.14	25.	122.
LEFT Y AXIS	2.74	66.15	-1.77	66.	217.
LEFT Z AXIS	3.58	10.46	2.43	75.	19.
LEFT RESULTANT	4.87	68.20	2.96	122.	273.
RIGHT X AXIS	-2.38	1.26	-362.43	254.	94.
RIGHT Y AXIS	0.45	77.80	-2.83	88.	217.
RIGHT Z AXIS	0.71	3.25	-8.17	62.	85.
RIGHT RESULTANT	2.60	370.45	1.03	94.	232.
SHOULDER ROLLER					
Y AXIS FORCE (LB)	-1.10	298.18	-9.09	92.	292.
Z AXIS FORCE (LB)	0.71	234.47	-2.83	92.	240.
X AXIS TORQUE (IN-LB)	2.90	563.06	-16.23	93.	318.



CHIA STUDY +GY TEST: 3493 SUBJ: ADAM-S WT: 143.0 NOM G: 14.0 CELL: F

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
HARNES ANCHOR FORCES (LB)					
LEFT HORIZ X AXIS	-5.91	3.28	-218.51	259.	86.
LEFT HORIZ Y AXIS	-1.98	189.43	-8.80	85.	291.
LEFT HORIZ Z AXIS	-1.80	1.73	-81.16	236.	87.
LEFT RESULTANT	6.51	300.36	1.85	87.	234.
RIGHT HORIZ X AXIS	-1.93	19.99	-89.34	50.	59.
RIGHT HORIZ Y AXIS	6.86	521.30	0.77	50.	319.
RIGHT HORIZ Z AXIS	-2.66	-1.04	-288.73	0.	53.
RIGHT RESULTANT	7.63	576.81	6.89	51.	5.
LEFT VERT X AXIS	-0.05	1.12	-51.19	21.	92.
LEFT VERT Y AXIS	-0.05	207.16	-1.32	95.	237.
LEFT VERT Z AXIS	-0.80	2.56	-588.61	281.	97.
LEFT RESULTANT	1.19	625.58	0.54	97.	253.
RIGHT VERT X AXIS	-1.74	5.41	-3.61	69.	35.
RIGHT VERT Y AXIS	0.06	44.76	-3.52	59.	310.
RIGHT VERT Z AXIS	-1.60	0.13	-57.77	1.	309.
RIGHT RESULTANT	2.79	57.90	1.91	310.	2.
ADAM INTERNAL TEMP (DEG C)	129.10	130.85	128.85	44.	1.
ADAM ACCELERATIONS (G)					
HEAD Y AXIS	-0.02	34.21	-3.48	118.	209.
HEAD Z AXIS	1.06	3.83	-36.26	52.	89.
CHEST Y AXIS	0.24	29.28	-3.23	71.	289.
LUMBAR Y AXIS	-0.08	36.70	-1.47	52.	269.
ADAM FORCES (LB)					
NECK Y AXIS	-3.03	22.47	-246.55	210.	115.
NECK Z AXIS	0.20	491.34	-43.30	110.	49.
LUMBAR Y AXIS	12.01	663.48	-1639.56	99.	49.
ADAM NECK MX TORQUE (IN-LB)	7.27	831.75	-246.64	115.	77.

CHIA STUDY +GY TEST: 3494 SUBJ: ADAM-S WT: 143.0 NOH G: 11.0 CELL: B

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK TIME (MS)				-322.	
2.5V EXT POWER (VOLTS)	2.50	2.50	2.50	58.	48.
10V EXT POWER (VOLTS)	10.00	10.00	10.00	1.	221.
SLED ACCELERATION (G)					
X AXIS	-0.02	0.25	-1.26	85.	59.
Y AXIS	0.02	11.22	-0.50	97.	235.
Z AXIS	1.00	1.55	-0.12	71.	76.
SEAT ACCELERATION (G)					
X AXIS	0.22	3.01	-1.71	89.	58.
Y AXIS	-0.03	18.66	-1.28	82.	239.
Z AXIS	0.94	4.79	-2.21	84.	93.
RESULTANT	0.97	18.97	0.67	82.	230.
CHEST ACCELERATION (G)					
X AXIS	0.08	15.75	-7.38	61.	95.
Y AXIS	0.16	35.09	-1.60	62.	71.
Z AXIS	1.05	7.20	-7.91	66.	124.
RESULTANT	1.06	38.51	0.44	61.	255.
RY (RAD/SEC?)	-7.84	2098.47	-2097.10	87.	94.
SLED VELOCITY (FPS)	0.02	51.81	0.02	231.	0.
SHOULDER STRAP FORCES (LB)					
LEFT X AXIS	-1.65	4.32	-34.96	116.	86.
LEFT Y AXIS	3.29	56.20	-0.21	73.	269.
LEFT Z AXIS	4.84	12.39	-0.23	84.	78.
LEFT RESULTANT	6.10	62.39	4.48	73.	242.
RIGHT X AXIS	-3.01	0.95	-311.36	266.	123.
RIGHT Y AXIS	0.96	72.77	-2.01	122.	269.
RIGHT Z AXIS	1.06	4.19	-7.23	73.	78.
RIGHT RESULTANT	3.43	319.78	1.07	123.	278.
SHOULDER ROLLER					
Y AXIS FORCE (LB)	-2.30	250.11	-7.42	121.	269.
Z AXIS FORCE (LB)	-0.89	180.54	-5.58	87.	266.
X AXIS TORQUE (IN-LB)	-4.05	478.24	-5.41	124.	2.

CHIA STUDY +GY TEST: 3494 SUBJ: ADAM-S WT: 143.0 NOM G: 11.0 CELL: B

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
HARNES ANCHOR FORCES (LB)					
LEFT HORIZ X AXIS	-8.25	-2.91	-274.68	278.	94.
LEFT HORIZ Y AXIS	11.82	232.66	8.35	69.	274.
LEFT HORIZ Z AXIS	8.61	75.21	4.94	72.	268.
LEFT RESULTANT	16.81	335.30	10.12	93.	280.
RIGHT HORIZ X AXIS	-13.53	6.59	-41.83	66.	118.
RIGHT HORIZ Y AXIS	-17.92	54.58	-17.52	68.	0.
RIGHT HORIZ Z AXIS	15.67	22.14	-4.78	120.	68.
RIGHT RESULTANT	27.40	54.83	6.27	68.	25.
LEFT VERT X AXIS	-0.11	26.84	-1.14	82.	7.
LEFT VERT Y AXIS	-0.05	161.45	-1.27	91.	268.
LEFT VERT Z AXIS	-1.63	0.41	-308.38	6.	92.
LEFT RESULTANT	1.75	347.54	0.41	92.	6.
RIGHT VERT X AXIS	1.88	20.07	-1.59	115.	32.
RIGHT VERT Y AXIS	0.54	45.90	-0.66	71.	3.
RIGHT VERT Z AXIS	-7.87	-2.06	-69.60	21.	115.
RIGHT RESULTANT	8.17	77.90	5.32	116.	269.
ADAM INTERNAL TEMP (DEG C)	124.29	124.35	123.60	0.	46.
ADAM ACCELERATIONS (G)					
HEAD Y AXIS	-0.08	26.35	-2.54	127.	242.
HEAD Z AXIS	1.06	8.23	-21.40	62.	94.
CHEST Y AXIS	0.11	23.17	-0.40	62.	280.
LUMBAR Y AXIS	-0.02	28.86	-0.29	76.	279.
ADAM FORCES (LB)					
NECK Y AXIS	-2.88	16.00	-170.82	237.	125.
NECK Z AXIS	-30.66	346.60	-108.05	128.	62.
LUMBAR Y AXIS	-21.71	357.20	-47.36	118.	44.
ADAM NECK MX TORQUE (IN-LB)					
	-4.48	544.05	-208.04	127.	66.

CHIA STUDY +GY TEST: 3495 SUBJ: ADAM-S WT: 143.0 NOM G: 11.0 CELL: B

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK TIME (MS)				-390.	
2.5V EXT POWER (VOLTS)	2.50	2.50	2.50	45.	1.
10V EXT POWER (VOLTS)	10.00	10.00	10.00	0.	1.
SLED ACCELERATION (G)					
X AXIS	0.00	0.30	-1.15	70.	62.
Y AXIS	0.02	10.97	0.15	90.	0.
Z AXIS	0.98	1.54	0.01	75.	80.
SEAT ACCELERATION (G)					
X AXIS	0.24	2.41	-1.40	92.	62.
Y AXIS	-0.03	17.34	0.10	83.	0.
Z AXIS	0.93	4.71	-1.82	86.	94.
RESULTANT	0.96	17.44	0.94	83.	2.
CHEST ACCELERATION (G)					
X AXIS	-0.06	17.93	-9.09	66.	72.
Y AXIS	0.36	34.90	-1.48	65.	72.
Z AXIS	1.17	10.08	-5.44	85.	115.
RESULTANT	1.23	39.37	1.16	65.	6.
RY (RAD/SEC2)	-5.97	2284.64	-1914.75	75.	63.
SLED VELOCITY (FPS)	0.01	49.77	0.02	210.	0.
SHOULDER STRAP FORCES (LB)					
LEFT X AXIS	1.37	7.11	-24.32	117.	147.
LEFT Y AXIS	3.50	48.40	3.50	72.	0.
LEFT Z AXIS	4.84	10.58	2.55	86.	46.
LEFT RESULTANT	6.15	49.32	5.23	76.	0.
RIGHT X AXIS	-3.67	-3.52	-296.06	1.	90.
RIGHT Y AXIS	0.49	65.79	0.35	124.	2.
RIGHT Z AXIS	1.22	2.59	-7.56	16.	81.
RIGHT RESULTANT	3.95	302.31	3.77	90.	2.
SHOULDER ROLLER					
Y AXIS FORCE (LB)	0.23	244.86	1.53	91.	0.
Z AXIS FORCE (LB)	1.86	193.57	1.86	87.	0.
X AXIS TORQUE (IN-LB)	8.20	464.52	8.20	87.	0.

CHIA STUDY +GY TEST: 3495 SUBJ: ADAM-S WT: 143.0 NOM G: 11.0 CELL: B

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
HARNES ANCHOR FORCES (LB)					
LEFT HORIZ X AXIS	-7.99	-6.31	-309.32	4.	92.
LEFT HORIZ Y AXIS	8.84	275.02	8.97	75.	0.
LEFT HORIZ Z AXIS	8.03	99.71	7.82	75.	0.
LEFT RESULTANT	14.39	412.50	13.47	82.	4.
RIGHT HORIZ X AXIS	-10.75	4.81	-23.30	64.	107.
RIGHT HORIZ Y AXIS	-10.78	55.64	-11.18	69.	0.
RIGHT HORIZ Z AXIS	15.01	15.14	-5.05	0.	70.
RIGHT RESULTANT	21.39	55.95	7.46	70.	24.
LEFT VERT X AXIS	-0.49	32.92	-1.14	83.	10.
LEFT VERT Y AXIS	-0.17	157.61	-0.03	81.	0.
LEFT VERT Z AXIS	0.17	0.41	-269.78	0.	93.
LEFT RESULTANT	1.00	310.91	0.41	80.	0.
RIGHT VERT X AXIS	0.36	16.53	-1.52	76.	31.
RIGHT VERT Y AXIS	0.31	41.70	0.31	69.	0.
RIGHT VERT Z AXIS	-4.30	-0.84	-42.65	23.	111.
RIGHT RESULTANT	4.34	51.68	4.07	118.	0.
ADAM INTERNAL TEMP (DEG C)	120.30	120.85	120.10	22.	151.
ADAM ACCELERATIONS (G)					
HEAD Y AXIS	0.13	24.33	-0.46	130.	22.
HEAD Z AXIS	1.12	7.64	-19.82	63.	94.
CHEST Y AXIS	0.37	24.79	0.41	62.	0.
LUMBAR Y AXIS	-0.04	27.18	-0.04	62.	0.
ADAM FORCES (LB)					
NECK Y AXIS	-4.08	5.08	-172.53	49.	129.
NECK Z AXIS	-4.91	308.72	-85.60	124.	63.
LUMBAR Y AXIS	-9.70	351.67	-43.02	119.	52.
ADAM NECK MX TORQUE (IN-LB)	-2.60	573.02	-222.84	127.	67.

CHIA STUDY +GY TEST: 3496 SUBJ: ADAM-S WT: 143.0 NOM G: 14.0 CELL: C

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK TIME (MS)				-258.	
2.5V EXT POWER (VOLTS)	2.50	2.51	2.50	341.	0.
10V EXT POWER (VOLTS)	10.00	10.00	10.00	285.	0.
SLED ACCELERATION (G)					
X AXIS	-0.02	0.89	-1.43	336.	59.
Y AXIS	0.01	14.50	-0.50	89.	214.
Z AXIS	0.98	1.30	-0.25	211.	96.
SEAT ACCELERATION (G)					
X AXIS	0.23	2.97	-2.79	85.	62.
Y AXIS	-0.01	28.38	-1.55	67.	220.
Z AXIS	0.94	3.86	-2.06	76.	71.
RESULTANT	0.97	28.60	0.63	67.	210.
CHEST ACCELERATION (G)					
X AXIS	0.23	23.79	-14.87	60.	67.
Y AXIS	0.20	41.38	-2.75	60.	283.
Z AXIS	1.02	7.59	-7.02	86.	115.
RESULTANT	1.06	47.76	0.88	60.	248.
RY (RAD/SEC2)	-2.79	2808.51	-2158.92	63.	58.
SLED VELOCITY (FPS)	0.02	58.92	0.01	208.	1.
SHOULDER STRAP FORCES (LB)					
LEFT X AXIS	-1.26	2.59	-60.26	35.	91.
LEFT Y AXIS	2.46	79.46	-2.28	74.	217.
LEFT Z AXIS	3.35	11.42	-4.63	91.	72.
LEFT RESULTANT	4.38	79.70	2.33	75.	286.
RIGHT X AXIS	-1.26	2.77	-392.55	227.	116.
RIGHT Y AXIS	0.38	98.57	-4.25	75.	220.
RIGHT Z AXIS	1.00	3.73	-11.49	58.	85.
RIGHT RESULTANT	1.75	401.86	0.90	117.	229.
SHOULDER ROLLER					
Y AXIS FORCE (LB)	0.24	328.62	-7.07	116.	291.
Z AXIS FORCE (LB)	1.06	250.42	-2.70	90.	246.
X AXIS TORQUE (IN-LB)	2.99	648.91	-12.35	114.	333.

CHIA STUDY +GY TEST: 3496 SUBJ: ADAM-S WT: 143.0 NOM G: 14.0 CELL: C

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
HARNESS ANCHOR FORCES (LB)					
LEFT HORIZ X AXIS	-8.14	0.03	-365.46	289.	88.
LEFT HORIZ Y AXIS	13.22	241.21	-0.49	68.	295.
LEFT HORIZ Z AXIS	9.90	96.94	-0.36	89.	295.
LEFT RESULTANT	18.44	436.35	0.61	88.	313.
RIGHT HORIZ X AXIS	-11.70	6.50	-38.80	67.	328.
RIGHT HORIZ Y AXIS	-15.82	54.66	-15.69	67.	0.
RIGHT HORIZ Z AXIS	14.89	22.78	-4.14	323.	62.
RIGHT RESULTANT	24.69	55.05	5.39	67.	214.
LEFT VERT X AXIS	-0.10	26.67	-1.31	66.	317.
LEFT VERT Y AXIS	0.33	212.63	-3.48	85.	291.
LEFT VERT Z AXIS	0.86	2.97	-409.43	279.	88.
LEFT RESULTANT	1.00	460.41	1.00	88.	0.
RIGHT VERT X AXIS	1.67	16.24	0.00	67.	4.
RIGHT VERT Y AXIS	0.66	55.18	-1.72	68.	218.
RIGHT VERT Z AXIS	-2.12	-2.12	-60.01	C.	110.
RIGHT RESULTANT	2.95	70.71	2.12	110.	231.
ADAM INTERNAL TEMP (DEG C)	132.57	132.85	132.10	195.	19.
ADAM ACCELERATIONS (G)					
HEAD Y AXIS	0.04	30.43	-2.55	119.	208.
HEAD Z AXIS	1.02	9.13	-31.57	59.	88.
CHEST Y AXIS	0.11	29.15	-3.97	77.	276.
LUMBAR Y AXIS	-0.04	49.20	-2.72	61.	281.
ADAM FORCES (LB)					
NECK Y AXIS	-0.98	17.39	-176.01	229.	120.
NECK Z AXIS	-4.13	435.04	-98.20	118.	59.
LUMBAR Y AXIS	-0.23	970.87	-2265.62	71.	61.
ADAM NECK MX TORQUE (IN-LB)	0.31	728.37	-174.93	116.	62.

CHIA STUDY +GY TEST: 3497 SUBJ: ADAM-L WT: 216.0 NOM G: 8.0 CELL: D

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK TIME (MS)				-96.	
2.5V EXT POWER (VOLTS)	2.50	2.50	2.50	450.	7.
10V EXT POWER (VOLTS)	10.00	10.00	10.00	2.	58.
SLED ACCELERATION (G)					
X AXIS	-0.02	0.51	-1.37	66.	59.
Y AXIS	0.00	7.78	-0.50	61.	281.
Z AXIS	0.97	1.41	0.24	282.	57.
SEAT ACCELERATION (G)					
X AXIS	0.28	1.72	-2.22	96.	58.
Y AXIS	-0.06	11.56	-0.82	90.	304.
Z AXIS	0.92	2.81	-1.11	96.	53.
RESULTANT	0.96	11.63	0.69	90.	330.
CHEST ACCELERATION (G)					
X AXIS	0.08	6.13	-13.12	87.	105.
Y AXIS	0.09	20.89	-2.29	88.	363.
Z AXIS	1.19	5.37	-6.17	91.	107.
RESULTANT	1.20	22.05	0.66	88.	386.
RY (RAD/SEC2)	-6.03	974.38	-947.63	112.	106.
SLED VELOCITY (FPS)	0.02	41.36	0.04	260.	0.
SHOULDER STRAP FORCES (LB)					
LEFT X AXIS	-6.99	4.95	-28.44	49.	110.
LEFT Y AXIS	8.20	39.85	5.32	90.	315.
LEFT Z AXIS	8.91	14.91	3.44	58.	53.
LEFT RESULTANT	14.00	44.73	9.59	110.	303.
RIGHT X AXIS	-5.29	4.66	-370.89	303.	102.
RIGHT Y AXIS	1.70	78.59	-0.86	93.	298.
RIGHT Z AXIS	2.56	7.59	-6.37	59.	100.
RIGHT RESULTANT	6.14	378.70	0.77	102.	407.
SHOULDER ROLLER					
Y AXIS FORCE (LB)	-0.66	270.61	-6.46	100.	313.
Z AXIS FORCE (LB)	5.60	173.11	-3.70	99.	303.
X AXIS TORQUE (IN-LB)	-2.68	472.77	-13.61	99.	323.



CHIA STUDY +GY TEST: 3497 SUBJ: ADAM-L WT: 216.0 NOM G: 8.0 CELL: D

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
HARNES ANCHOR FORCES (LB)					
LEFT HORIZ X AXIS	-9.81	16.68	-108.27	366.	110.
LEFT HORIZ Y AXIS	-10.02	50.84	-29.14	116.	353.
LEFT HORIZ Z AXIS	-1.37	5.84	-19.39	298.	108.
LEFT RESULTANT	14.10	117.51	1.22	113.	248.
RIGHT HORIZ X AXIS	-13.68	9.87	-154.13	43.	72.
RIGHT HORIZ Y AXIS	10.42	244.44	-5.27	71.	366.
RIGHT HORIZ Z AXIS	-6.66	-3.30	-87.42	309.	101.
RIGHT RESULTANT	18.44	293.34	16.30	72.	300.
LEFT VERT X AXIS	-1.71	1.19	-69.37	306.	107.
LEFT VERT Y AXIS	-0.13	137.17	-2.67	107.	300.
LEFT VERT Z AXIS	-6.34	1.79	-556.88	337.	110.
LEFT RESULTANT	6.59	577.70	0.28	110.	317.
RIGHT VERT X AXIS	-1.70	-0.04	-7.25	5.	59.
RIGHT VERT Y AXIS	0.37	29.35	-3.42	69.	305.
RIGHT VERT Z AXIS	-0.77	2.57	-29.59	296.	68.
RIGHT RESULTANT	2.07	42.30	0.64	69.	268.
ADAM INTERNAL TEMP (DEG C)	107.85	108.00	107.50	0.	7.
ADAM ACCELERATIONS (G)					
HEAD Y AXIS	-0.12	17.27	-2.58	139.	391.
HEAD Z AXIS	1.10	1.95	-22.43	346.	105.
CHEST Y AXIS	-0.15	17.41	-2.00	85.	357.
LUMBAR Y AXIS	0.11	18.05	-1.18	76.	336.
ADAM FORCES (LB)					
NECK Y AXIS	1.48	32.95	-184.23	62.	131.
NECK Z AXIS	14.65	256.59	-8.26	106.	62.
LUMBAR Y AXIS	14.14	184.99	-247.20	118.	72.
ADAM NECK MX TORQUE (IN-LB)	13.59	601.24	-187.50	136.	83.

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CHIA STUDY -GX TEST: 3498 SUBJ: ADAM-L WT: 216.0 NOM G: 10.0 CELL: G

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK TIME (MS)				-89.	
2.5V EXT POWER (VOLTS)	2.50	2.51	2.50	413.	27.
10V EXT POWER (VOLTS)	10.00	10.00	10.00	59.	29.
SLED ACCELERATION (G)					
X AXIS	-0.03	0.65	-9.62	161.	55.
Y AXIS	0.00	0.62	-0.35	297.	69.
Z AXIS	1.00	1.69	-0.60	52.	47.
SEAT ACCELERATION (G)					
X AXIS	0.45	2.58	-11.09	168.	47.
Y AXIS	-0.03	1.83	-2.39	197.	185.
Z AXIS	0.85	7.32	-0.12	52.	172.
RESULTANT	0.96	11.85	0.47	47.	194.
CHEST ACCELERATION (G)					
X AXIS	0.42	9.56	-15.75	232.	84.
Y AXIS	0.12	7.95	-8.70	94.	88.
Z AXIS	0.92	13.69	-7.57	71.	231.
RESULTANT	1.02	19.82	0.26	85.	503.
RY (RAD/SEC2)	-0.94	2474.55	-2538.74	237.	257.
SLED VELOCITY (FPS)	0.03	29.46	0.03	160.	1.
SHOULDER POINT FORCES (LB)					
LEFT X AXIS	-5.38	4.18	-280.06	206.	93.
LEFT Y AXIS	2.01	8.43	-21.50	196.	74.
LEFT Z AXIS	2.16	20.51	-1.28	52.	173.
LEFT RESULTANT	6.21	280.95	1.84	93.	276.
RIGHT X AXIS	-8.03	3.89	-206.67	204.	90.
RIGHT Y AXIS	1.02	24.70	-5.68	86.	210.
RIGHT Z AXIS	0.63	14.59	-3.17	51.	173.
RIGHT RESULTANT	8.13	208.09	0.66	90.	216.
SHOULDER ROLLER					
Y AXIS FORCE (LB)	2.62	15.74	-19.79	69.	118.
Z AXIS FORCE (LB)	5.90	314.39	-3.59	89.	194.
X AXIS TORQUE (IN-LB)	2.20	34.05	-102.58	51.	98.

CHIA STUDY -GX TEST: 3498 SUBJ: ADAM-L WT: 216.0 NOM G: 10.0 CELL: G

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
HARNES ANCHOR FORCES (LB)					
LEFT HORIZ X AXIS	-4.43	19.97	-482.35	340.	96.
LEFT HORIZ Y AXIS	-7.34	17.13	-17.83	92.	208.
LEFT HORIZ Z AXIS	-3.89	32.89	-17.82	53.	195.
LEFT RESULTANT	9.68	482.58	3.53	96.	261.
RIGHT HORIZ X AXIS	-10.09	4.40	-535.59	200.	93.
RIGHT HORIZ Y AXIS	-1.14	5.65	-47.37	44.	85.
RIGHT HORIZ Z AXIS	-6.60	22.93	-27.80	52.	97.
RIGHT RESULTANT	12.28	537.26	2.47	95.	197.
LEFT VERT X AXIS	-0.18	0.29	-87.30	0.	95.
LEFT VERT Y AXIS	-2.42	9.03	-7.50	92.	66.
LEFT VERT Z AXIS	-3.61	12.41	-171.34	43.	97.
LEFT RESULTANT	4.54	192.40	0.36	97.	447.
RIGHT VERT X AXIS	-0.45	6.53	-36.99	233.	92.
RIGHT VERT Y AXIS	0.99	6.69	-3.66	178.	59.
RIGHT VERT Z AXIS	-1.44	10.68	-72.94	50.	102.
RIGHT RESULTANT	2.54	80.23	1.28	102.	8.
ADAM INTERNAL TEMP (DEG C)	91.98	92.08	91.33	110.	12.
ADAM ACCELERATIONS (G)					
HEAD X AXIS	0.42	7.69	-16.09	261.	105.
HEAD Z AXIS	0.84	5.71	-5.57	65.	94.
CHEST X AXIS	0.00	11.19	-13.32	225.	91.
LUMBAR X AXIS	0.53	7.23	-13.36	224.	76.
ADAM FORCES (LB)					
NECK X AXIS	-16.37	148.11	-87.80	111.	261.
NECK Z AXIS	-4.59	72.79	-63.07	243.	50.
LUMBAR X AXIS	15.96	153.00	-104.96	232.	100.
ADAM NECK MY TORQUE (IN-LB)	12.32	175.87	-152.13	110.	251.

CHIA STUDY -GX TEST: 3499 SUBJ: ADAM-L WT: 216.0 NOM G: 20.0 CELL: H

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK TIME (MS)				-109.	
2.5V EXT POWER (VOLTS)	2.50	2.50	2.50	40.	0.
10V EXT POWER (VOLTS)	10.00	10.00	10.00	0.	270.
SLED ACCELERATION (G)					
X AXIS	-0.03	0.62	-19.72	180.	78.
Y AXIS	-0.02	1.41	-0.86	275.	259.
Z AXIS	0.96	2.98	-0.59	259.	35.
SEAT ACCELERATION (G)					
X AXIS	0.54	3.99	-19.16	258.	77.
Y AXIS	-0.08	2.40	-1.72	72.	261.
Z AXIS	0.80	11.79	-1.31	41.	273.
RESULTANT	0.97	22.27	0.36	77.	271.
CHEST ACCELERATION (G)					
X AXIS	0.49	10.80	-34.23	255.	68.
Y AXIS	0.08	18.96	-10.74	275.	68.
Z AXIS	1.01	32.41	-9.26	76.	253.
RESULTANT	1.12	45.67	0.25	68.	234.
RY (RAD/SEC2)	-9.80	4231.03	-4236.53	266.	281.
SLED VELOCITY (FPS)	-0.01	73.80	0.01	183.	0.
SHOULDER POINT FORCES (LB)					
LEFT X AXIS	-5.21	10.58	-640.82	259.	74.
LEFT Y AXIS	6.70	13.61	-41.63	340.	64.
LEFT Z AXIS	6.12	36.47	-1.38	41.	274.
LEFT RESULTANT	10.56	642.92	5.00	74.	336.
RIGHT X AXIS	-8.57	11.04	-545.17	258.	70.
RIGHT Y AXIS	2.04	58.31	-4.79	69.	263.
RIGHT Z AXIS	2.03	26.13	-5.58	41.	274.
RIGHT RESULTANT	9.15	548.45	1.02	70.	301.
SHOULDER ROLLER					
Y AXIS FORCE (LB)	-0.68	44.40	-37.30	68.	109.
Z AXIS FORCE (LB)	5.48	772.97	-16.39	71.	273.
X AXIS TORQUE (IN-LB)	0.00	103.83	-153.02	52.	80.

CHIA STUDY -GX TEST: 3499 SUBJ: ADAM-L WT: 216.0 NOM G: 20.0 CELL: H

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
HARNES ANCHOR FORCES (LB)					
LEFT HORIZ X AXIS	-7.30	42.45	-1621.46	256.	83.
LEFT HORIZ Y AXIS	-7.73	171.19	-17.55	89.	262.
LEFT HORIZ Z AXIS	-14.83	47.30	-32.38	41.	486.
LEFT RESULTANT	18.37	1630.11	12.20	83.	312.
RIGHT HORIZ X AXIS	-12.02	51.49	-1706.60	258.	85.
RIGHT HORIZ Y AXIS	8.92	14.49	-144.57	28.	89.
RIGHT HORIZ Z AXIS	-10.00	27.46	-33.41	28.	75.
RIGHT RESULTANT	18.13	1712.63	6.85	87.	311.
LEFT VERT X AXIS	-1.54	2.58	-252.89	307.	80.
LEFT VERT Y AXIS	-1.01	101.62	-7.70	81.	271.
LEFT VERT Z AXIS	-16.67	17.72	-370.20	29.	80.
LEFT RESULTANT	16.82	459.70	1.40	81.	460.
RIGHT VERT X AXIS	-1.52	5.88	-128.32	258.	81.
RIGHT VERT Y AXIS	1.06	7.69	-26.80	244.	86.
RIGHT VERT Z AXIS	-9.45	13.19	-189.43	26.	110.
RIGHT RESULTANT	9.67	226.88	1.62	83.	430.
ADAM INTERNAL TEMP (DEG C)	-258.44	-257.68	-258.92	269.	96.
ADAM ACCELERATIONS (G)					
HEAD X AXIS	0.20	8.34	-51.91	255.	88.
HEAD Z AXIS	0.94	181.31	-89.34	86.	126.
CHEST X AXIS	0.89	86.43	-69.11	53.	59.
LUMBAR X AXIS	0.47	8.17	-29.82	251.	58.
ADAM FORCES (LB)					
NECK X AXIS	-4.92	506.37	-88.18	88.	285.
NECK Z AXIS	-20.96	245.53	-82.45	75.	53.
LUMBAR X AXIS	-5.61	196.86	-1213.87	254.	90.
ADAM NECK MY TORQUE (IN-LB)	-7.81	601.32	-234.28	83.	273.

CHIA STUDY -GX TEST: 3500 SUBJ: ADAM-S WT: 143.0 NOM G: 10.0 CELL: G

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK TIME (MS)				-95.	
2.5V EXT POWER (VOLTS)	2.50	2.51	2.50	22.	7.
10V EXT POWER (VOLTS)	10.00	10.00	10.00	0.	22.
SLED ACCELERATION (G)					
X AXIS	-0.02	0.48	-9.64	159.	55.
Y AXIS	0.00	0.44	-0.32	58.	324.
Z AXIS	0.98	2.02	-0.29	257.	47.
SEAT ACCELERATION (G)					
X AXIS	0.55	3.22	-10.62	165.	48.
Y AXIS	-0.04	2.16	-2.40	196.	182.
Z AXIS	0.82	7.07	-0.40	53.	169.
RESULTANT	0.99	11.69	0.42	64.	192.
CHEST ACCELERATION (G)					
X AXIS	0.56	8.24	-10.86	223.	76.
Y AXIS	0.23	2.85	-3.22	108.	116.
Z AXIS	0.90	13.18	-3.59	68.	231.
RESULTANT	1.09	15.93	0.42	70.	174.
RY (RAD/SEC2)	-11.64	1378.65	-2060.34	237.	252.
SLED VELOCITY (FPS)	0.00	29.73	0.00	160.	0.
SHOULDER POINT FORCES (LB)					
LEFT X AXIS	-5.57	11.13	-170.47	224.	79.
LEFT Y AXIS	2.62	11.60	-10.27	174.	75.
LEFT Z AXIS	2.42	19.84	-1.95	53.	170.
LEFT RESULTANT	6.75	171.39	0.79	81.	359.
RIGHT X AXIS	-5.98	5.32	-181.41	182.	79.
RIGHT Y AXIS	0.63	14.16	-4.53	70.	207.
RIGHT Z AXIS	0.64	15.91	-4.39	53.	169.
RIGHT RESULTANT	6.10	181.98	1.48	79.	201.
SHOULDER ROLLER					
Y AXIS FORCE (LB)	-1.80	49.98	-10.41	242.	187.
Z AXIS FORCE (LB)	4.39	250.87	-14.74	80.	248.
X AXIS TORQUE (IN-LB)	0.16	155.81	-40.93	242.	102.

CHIA STUDY -GX TEST: 3500 SUBJ: ADAM-S WT: 143.0 NOM G: 10.0 CELL: G

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
HARNES ANCHOR FORCES (LB)					
LEFT HORIZ X AXIS	-1.69	6.28	-364.17	203.	81.
LEFT HORIZ Y AXIS	-2.28	63.05	-13.84	82.	212.
LEFT HORIZ Z AXIS	-0.34	32.67	-7.17	52.	170.
LEFT RESULTANT	3.52	370.23	0.16	82.	2.
RIGHT HORIZ X AXIS	-6.77	6.03	-383.27	482.	86.
RIGHT HORIZ Y AXIS	-1.38	4.74	-69.49	178.	85.
RIGHT HORIZ Z AXIS	-0.25	33.95	-6.63	53.	170.
RIGHT RESULTANT	7.18	389.58	1.24	86.	204.
LEFT VERT X AXIS	-1.60	0.92	-50.17	353.	83.
LEFT VERT Y AXIS	-0.98	24.15	-6.36	87.	186.
LEFT VERT Z AXIS	-8.40	8.25	-85.67	42.	86.
LEFT RESULTANT	8.64	101.00	0.93	87.	386.
RIGHT VERT X AXIS	-2.11	1.38	-49.40	208.	80.
RIGHT VERT Y AXIS	0.10	5.21	-12.04	175.	90.
RIGHT VERT Z AXIS	-1.87	6.18	-71.01	24.	90.
RIGHT RESULTANT	3.21	87.34	1.40	90.	396.
ADAM INTERNAL TEMP (DEG C)	81.78	81.56	80.81	0.	172.
ADAM ACCELERATIONS (G)					
HEAD X AXIS	0.53	36.99	-18.14	241.	104.
HEAD Z AXIS	0.86	4.45	-6.02	53.	82.
CHEST X AXIS	0.14	6.62	-12.67	217.	70.
LUMBAR X AXIS	0.60	4.25	-13.72	218.	79.
ADAM FORCES (LB)					
NECK X AXIS	-5.98	149.97	-59.68	103.	224.
NECK Z AXIS	-1.92	204.90	-39.26	243.	50.
LUMBAR X AXIS	7.64	123.28	-51.25	227.	94.
ADAM NECK MY TORQUE (IN-LB)	-5.39	119.98	-112.84	95.	242.

CHIA STUDY -GX TEST: 3501 SUBJ: ADAM-S WT: 143.0 NOM G: 10.0 CELL: G

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK TIME (MS)				-85.	
2.5V EXT POWER (VOLTS)	2.50	2.50	2.50	0.	494.
10V EXT POWER (VOLTS)	10.00	10.00	10.00	142.	449.
SLED ACCELERATION (G)					
X AXIS	-0.05	0.46	-9.61	183.	56.
Y AXIS	-0.04	0.48	-0.35	57.	192.
Z AXIS	0.78	1.54	-0.37	164.	47.
SEAT ACCELERATION (G)					
X AXIS	0.73	3.48	-10.36	164.	47.
Y AXIS	-0.08	2.29	-2.50	194.	181.
Z AXIS	0.79	6.91	-0.39	52.	168.
RESULTANT	1.08	11.37	0.26	64.	191.
CHEST ACCELERATION (G)					
X AXIS	0.75	7.68	-11.57	224.	77.
Y AXIS	0.17	2.30	-3.69	257.	76.
Z AXIS	0.68	12.17	-5.10	68.	238.
RESULTANT	1.03	16.16	0.22	70.	198.
RY (RAD/SEC2)	-0.02	2154.49	-1636.04	234.	219.
SLED VELOCITY (FPS)	0.02	29.63	-0.05	158.	0.
SHOULDER POINT FORCES (LB)					
LEFT X AXIS	3.73	15.87	-177.57	204.	79.
LEFT Y AXIS	-1.97	6.88	-14.99	173.	75.
LEFT Z AXIS	-3.26	15.05	-5.60	53.	168.
LEFT RESULTANT	5.57	178.33	1.19	79.	10.
RIGHT X AXIS	-4.60	5.64	-185.06	202.	78.
RIGHT Y AXIS	0.64	13.04	-4.49	70.	179.
RIGHT Z AXIS	-0.86	15.15	-3.88	53.	168.
RIGHT RESULTANT	4.84	185.58	1.68	78.	182.
SHOULDER ROLLER					
Y AXIS FORCE (LB)	-4.81	14.24	-14.17	230.	185.
Z AXIS FORCE (LB)	4.13	251.47	-10.40	73.	237.
X AXIS TORQUE (IN-LB)	2.27	38.64	-18.74	230.	107.



CHIA STUDY -GX TEST: 3501 SUBJ: ADAM-S WT: 143.0 NOM G: 10.0 CELL: G

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
HARNES ANCHOR FORCES (LB)					
LEFT HORIZ X AXIS	-8.23	5.78	-408.63	203.	81.
LEFT HORIZ Y AXIS	-3.95	72.14	-15.24	83.	231.
LEFT HORIZ Z AXIS	0.13	34.26	-5.58	52.	169.
LEFT RESULTANT	9.46	415.26	2.15	83.	226.
RIGHT HORIZ X AXIS	-6.64	6.40	-401.73	233.	82.
RIGHT HORIZ Y AXIS	0.37	9.61	-68.15	194.	85.
RIGHT HORIZ Z AXIS	-0.72	33.75	-6.83	53.	203.
RIGHT RESULTANT	7.05	407.52	1.00	85.	208.
LEFT VERT X AXIS	-0.89	1.17	-54.79	352.	80.
LEFT VERT Y AXIS	-4.06	26.70	-7.63	86.	185.
LEFT VERT Z AXIS	-4.59	9.23	-101.02	36.	84.
LEFT RESULTANT	6.40	117.98	2.99	86.	437.
RIGHT VERT X AXIS	0.29	3.92	-43.23	371.	81.
RIGHT VERT Y AXIS	-1.22	5.41	-8.38	173.	90.
RIGHT VERT Z AXIS	-0.50	9.52	-61.24	37.	87.
RIGHT RESULTANT	1.59	75.12	0.40	87.	3.
ADAM INTERNAL TEMP (DEG C)	97.86	98.10	97.35	44.	168.
ADAM ACCELERATIONS (G)					
HEAD X AXIS	0.94	58.58	-17.98	229.	104.
HEAD Z AXIS	0.86	5.41	-8.82	52.	231.
CHEST X AXIS	0.66	6.93	-13.18	222.	71.
LUMBAR X AXIS	0.63	3.94	-14.43	230.	77.
ADAM FORCES (LB)					
NECK X AXIS	-4.78	159.37	-55.16	104.	223.
NECK Z AXIS	-8.23	231.51	-57.56	231.	51.
LUMBAR X AXIS	47.14	150.58	-31.89	229.	147.
ADAM NECK MY TORQUE (IN-LB)	-14.11	151.26	-100.97	96.	231.

CHIA STUDY -GX TEST: 3502 SUBJ: ADAM-S WT: 143.0 NOM G: 10.0 CELL: L

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK TIME (MS)				-98.	
2.5V EXT POWER (VOLTS)	2.50	2.50	2.50	84.	26.
10V EXT POWER (VOLTS)	10.00	10.00	10.00	3.	85.
SLED ACCELERATION (G)					
X AXIS	-0.02	0.50	-9.67	160.	56.
Y AXIS	0.00	0.51	-0.19	57.	172.
Z AXIS	0.96	1.91	-0.31	209.	47.
SEAT ACCELERATION (G)					
X AXIS	0.50	3.24	-10.86	164.	47.
Y AXIS	-0.04	2.10	-2.73	194.	182.
Z AXIS	0.84	7.12	-0.43	52.	168.
RESULTANT	0.98	11.91	0.14	63.	191.
CHEST ACCELERATION (G)					
X AXIS	0.58	5.15	-10.99	211.	73.
Y AXIS	0.18	2.88	-1.73	106.	217.
Z AXIS	0.89	16.14	-4.78	73.	226.
RESULTANT	1.08	19.55	0.12	73.	238.
RY (RAD/SEC2)	-9.40	917.07	-1879.98	225.	74.
SLED VELOCITY (FPS)	0.03	30.02	0.04	157.	0.
SHOULDER POINT FORCES (LB)					
LEFT X AXIS	-4.66	5.21	-172.44	183.	76.
LEFT Y AXIS	2.76	10.77	-11.10	173.	74.
LEFT Z AXIS	2.67	19.52	-1.12	52.	169.
LEFT RESULTANT	6.17	173.59	1.87	76.	225.
RIGHT X AXIS	-2.59	6.12	-184.58	180.	78.
RIGHT Y AXIS	0.89	15.00	-3.69	70.	161.
RIGHT Z AXIS	0.74	16.59	-3.70	53.	169.
RIGHT RESULTANT	2.97	185.16	1.84	78.	245.
SHOULDER ROLLER					
Y AXIS FORCE (LB)	-2.52	12.65	-10.44	173.	160.
Z AXIS FORCE (LB)	3.30	250.50	-3.89	72.	193.
X AXIS TORQUE (IN-LB)	-4.38	33.66	-26.45	79.	97.

CHIA STUDY -GX TEST: 3502 SUBJ: ADAM-S WT: 143.0 NOM G: 10.0 CELL: L

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
HARNESSE ANCHOR FORCES (LB)					
LEFT HORIZ X AXIS	-11.24	-0.38	-320.60	198.	74.
LEFT HORIZ Y AXIS	15.01	170.00	2.24	69.	200.
LEFT HORIZ Z AXIS	12.05	184.78	3.69	69.	188.
LEFT RESULTANT	22.49	407.22	4.33	74.	200.
RIGHT HORIZ X AXIS	-12.71	5.40	-308.55	370.	77.
RIGHT HORIZ Y AXIS	-15.98	-1.84	-167.97	194.	70.
RIGHT HORIZ Z AXIS	14.55	229.54	-0.41	68.	391.
RIGHT RESULTANT	25.16	418.24	2.08	77.	391.
LEFT VERT X AXIS	1.78	11.14	-15.62	157.	45.
LEFT VERT Y AXIS	-0.48	13.50	-6.84	94.	186.
LEFT VERT Z AXIS	-8.00	12.41	-65.17	52.	89.
LEFT RESULTANT	8.28	66.56	1.14	94.	10.
RIGHT VERT X AXIS	-0.29	14.07	-18.57	162.	45.
RIGHT VERT Y AXIS	-0.60	5.17	-15.52	198.	89.
RIGHT VERT Z AXIS	-4.17	5.73	-68.25	25.	87.
RIGHT RESULTANT	4.44	70.32	3.27	90.	366.
ADAM INTERNAL TEMP (DEG C)	84.23	84.74	82.99	84.	365.
ADAM ACCELERATIONS (G)					
HEAD X AXIS	0.60	10.54	-18.22	256.	103.
HEAD Z AXIS	0.83	4.50	-7.95	49.	84.
CHEST X AXIS	-0.16	5.78	-15.27	215.	68.
LUMBAR X AXIS	0.61	5.36	-13.01	210.	72.
ADAM FORCES (LB)					
NECK X AXIS	1.29	165.19	-46.09	104.	247.
NECK Z AXIS	-7.42	47.09	-53.94	253.	49.
LUMBAR X AXIS	11.85	145.50	-60.77	219.	93.
ADAM NECK MY TORQUE (IN-LB)	-6.84	140.47	-65.19	95.	240.

CHIA STUDY -GX TEST: 3503 SUBJ: ADAM-L WT: 216.0 NOM G: 10.0 CELL: L

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK TIME (MS)				-93.	
2.5V EXT POWER (VOLTS)	2.50	2.54	2.31	165.	163.
10V EXT POWER (VOLTS)	10.00	10.00	9.98	165.	163.
SLED ACCELERATION (G)					
X AXIS	-0.02	0.68	-9.64	161.	54.
Y AXIS	-0.02	0.54	-0.35	301.	68.
Z AXIS	0.96	2.02	-0.36	264.	46.
SEAT ACCELERATION (G)					
X AXIS	0.51	3.10	-10.83	168.	46.
Y AXIS	-0.07	2.33	-3.00	199.	186.
Z AXIS	0.81	7.15	-0.40	51.	172.
RESULTANT	0.96	11.84	0.38	63.	194.
CHEST ACCELERATION (G)					
X AXIS	0.50	13.09	-11.29	224.	94.
Y AXIS	0.10	9.75	-10.20	96.	91.
Z AXIS	0.87	12.64	-5.96	84.	221.
RESULTANT	1.00	16.55	0.14	96.	322.
RY (RAD/SEC2)	-0.59	1925.83	-2613.64	229.	222.
SLED VELOCITY (FPS)	0.02	29.39	0.03	162.	0.
SHOULDER POINT FORCES (LB)					
LEFT X AXIS	-8.29	3.71	-252.90	187.	93.
LEFT Y AXIS	5.02	12.06	-17.87	177.	74.
LEFT Z AXIS	4.95	22.50	1.86	51.	171.
LEFT RESULTANT	10.90	253.62	4.20	93.	185.
RIGHT X AXIS	-8.97	7.23	-215.26	206.	79.
RIGHT Y AXIS	1.82	24.56	-5.82	87.	209.
RIGHT Z AXIS	1.54	16.52	-1.24	52.	155.
RIGHT RESULTANT	9.31	215.93	0.72	79.	248.
SHOULDER ROLLER					
Y AXIS FORCE (LB)	0.21	12.58	-24.72	44.	102.
Z AXIS FORCE (LB)	10.07	306.61	-3.89	83.	194.
X AXIS TORQUE (IN-LB)	1.22	31.81	-80.23	117.	94.

CHIA STUDY -GX TEST: 3503 SUBJ: ADAM-L WT: 216.0 NOM G: 10.0 CELL: L

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
HARNES ANCHOR FORCES (LB)					
LEFT HORIZ X AXIS	-8.28	4.52	-491.51	221.	85.
LEFT HORIZ Y AXIS	8.46	239.14	-2.03	83.	213.
LEFT HORIZ Z AXIS	11.66	268.66	0.65	82.	217.
LEFT RESULTANT	16.65	607.69	2.38	85.	217.
RIGHT HORIZ X AXIS	-13.52	0.00	-464.64	198.	86.
RIGHT HORIZ Y AXIS	-7.63	-0.28	-201.76	218.	87.
RIGHT HORIZ Z AXIS	14.93	325.51	4.26	84.	200.
RIGHT RESULTANT	21.65	602.12	4.27	87.	218.
LEFT VERT X AXIS	3.26	17.86	-16.20	161.	46.
LEFT VERT Y AXIS	-0.64	7.47	-6.51	166.	74.
LEFT VERT Z AXIS	-2.53	9.88	-67.70	32.	156.
LEFT RESULTANT	4.25	69.11	2.38	156.	7.
RIGHT VERT X AXIS	2.26	20.67	-19.22	167.	45.
RIGHT VERT Y AXIS	0.25	4.90	-7.17	177.	107.
RIGHT VERT Z AXIS	-9.08	6.63	-86.64	51.	117.
RIGHT RESULTANT	9.45	87.85	3.22	117.	9.
ADAM INTERNAL TEMP (DEG C)	75.55	75.73	74.98	1.	393.
ADAM ACCELERATIONS (G)					
HEAD X AXIS	0.35	7.22	-15.35	253.	102.
HEAD Z AXIS	0.93	5.13	-3.54	62.	96.
CHEST X AXIS	0.62	10.55	-12.22	217.	80.
LUMBAR X AXIS	0.42	6.51	-13.08	218.	78.
ADAM FORCES (LB)					
NECK X AXIS	-4.64	148.01	-75.14	102.	254.
NECK Z AXIS	-5.73	295.64	-59.78	166.	64.
LUMBAR X AXIS	17.28	171.06	-175.57	226.	104.
ADAM NECK MY TORQUE (IN-LB)	12.18	246.46	-175.24	95.	243.

CHIA STUDY -GX TEST: 3504 SUBJ: ADAM-L WT: 216.0 NOM G: 20.0 CELL: M

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK TIME (MS)				-112.	
2.5V EXT POWER (VOLTS)	2.50	2.50	2.49	29.	455.
10V EXT POWER (VOLTS)	10.00	10.00	10.00	1.	326.
SLED ACCELERATION (G)					
X AXIS	-0.02	0.69	-20.20	179.	83.
Y AXIS	0.03	1.28	-0.75	272.	49.
Z AXIS	1.00	1.78	-0.22	252.	63.
SEAT ACCELERATION (G)					
X AXIS	0.48	2.18	-19.91	270.	62.
Y AXIS	-0.04	2.84	-2.70	287.	53.
Z AXIS	0.83	12.88	-0.19	57.	268.
RESULTANT	0.96	23.14	0.39	71.	284.
CHEST ACCELERATION (G)					
X AXIS	0.51	13.96	-48.77	245.	62.
Y AXIS	0.15	17.50	-11.90	263.	64.
Z AXIS	0.90	29.30	-7.89	58.	251.
RESULTANT	1.05	54.83	0.16	62.	469.
RY (RAD/SEC2)	-13.05	5667.45	-6697.63	250.	63.
SLED VELOCITY (FPS)	0.01	73.89	-0.02	183.	0.
SHOULDER POINT FORCES (LB)					
LEFT X AXIS	-11.84	4.10	-615.71	269.	69.
LEFT Y AXIS	2.28	10.43	-37.92	286.	60.
LEFT Z AXIS	3.33	35.62	0.07	68.	267.
LEFT RESULTANT	12.52	617.58	3.35	69.	470.
RIGHT X AXIS	-3.55	5.16	-535.16	258.	70.
RIGHT Y AXIS	1.12	51.41	-7.01	66.	272.
RIGHT Z AXIS	0.43	24.43	-3.48	37.	272.
RIGHT RESULTANT	3.78	537.53	1.52	70.	216.
SHOULDER ROLLER					
Y AXIS FORCE (LB)	-4.70	31.51	-14.67	114.	179.
Z AXIS FORCE (LB)	7.55	766.98	-11.15	68.	243.
X AXIS TORQUE (IN-LB)	-11.83	98.21	-87.60	108.	66.

CHIA STUDY -GX TEST: 3504 SUBJ: ADAM-L WT: 216.0 NOM G: 20.0 CELL: M

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
<b>HARNES ANCHOR FORCES (LB)</b>					
LEFT HORIZ X AXIS	-10.16	5.78	-1607.90	268.	74.
LEFT HORIZ Y AXIS	5.15	715.87	-7.62	72.	272.
LEFT HORIZ Z AXIS	7.86	883.34	-3.98	73.	261.
LEFT RESULTANT	14.11	1966.40	0.88	74.	230.
RIGHT HORIZ X AXIS	-14.48	-6.03	-1500.40	259.	74.
RIGHT HORIZ Y AXIS	-3.74	3.46	-636.31	287.	71.
RIGHT HORIZ Z AXIS	6.75	1015.76	-5.48	72.	270.
RIGHT RESULTANT	16.52	1917.43	6.16	74.	263.
LEFT VERT X AXIS	1.27	11.09	-40.00	173.	74.
LEFT VERT Y AXIS	-2.62	7.65	-7.60	97.	53.
LEFT VERT Z AXIS	-3.61	16.33	-81.67	35.	153.
LEFT RESULTANT	4.79	82.03	1.64	159.	301.
RIGHT VERT X AXIS	2.12	19.00	-31.77	168.	36.
RIGHT VERT Y AXIS	0.17	5.21	-27.56	289.	83.
RIGHT VERT Z AXIS	-6.12	16.27	-128.46	34.	94.
RIGHT RESULTANT	6.71	131.41	2.76	94.	302.
ADAM INTERNAL TEMP (DEG C)	81.55	83.58	81.33	133.	3.
<b>ADAM ACCELERATIONS (G)</b>					
HEAD X AXIS	0.34	8.53	-45.06	274.	88.
HEAD Z AXIS	1.00	6.28	-29.80	51.	70.
CHEST X AXIS	0.14	19.04	-35.86	240.	69.
LUMBAR X AXIS	0.48	8.70	-27.39	241.	75.
<b>ADAM FORCES (LB)</b>					
NECK X AXIS	-30.22	429.76	-81.90	87.	273.
NECK Z AXIS	-43.52	210.45	-79.10	70.	41.
LUMBAR X AXIS	59.77	264.09	-872.55	243.	85.
ADAM NECK MY TORQUE (IN-LB)	70.50	519.09	-234.51	82.	262.

CHIA STUDY -GX TEST: 3505 SUBJ: ADAM-L WT: 216.0 NOM G: 20.0 CELL: M

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK TIME (MS)				-99.	
2.5V EXT POWER (VOLTS)	2.50	2.51	2.49	56.	402.
10V EXT POWER (VOLTS)	10.00	10.00	10.00	0.	9.
SLED ACCELERATION (G)					
X AXIS	-0.04	0.70	-20.04	179.	79.
Y AXIS	-0.02	1.38	-0.95	269.	49.
Z AXIS	0.98	2.03	-0.27	254.	63.
SEAT ACCELERATION (G)					
X AXIS	0.51	2.97	-19.12	270.	74.
Y AXIS	-0.03	2.50	-2.73	69.	53.
Z AXIS	0.82	12.85	-0.32	57.	271.
RESULTANT	0.97	22.66	0.57	78.	298.
CHEST ACCELERATION (G)					
X AXIS	0.56	20.59	-32.98	244.	64.
Y AXIS	0.16	9.29	-12.58	264.	68.
Z AXIS	0.91	38.71	-7.28	72.	241.
RESULTANT	1.08	45.65	0.17	72.	492.
RY (RAD/SEC2)	0.30	5410.98	-5532.65	84.	68.
SLED VELOCITY (FPS)	0.02	73.30	0.01	183.	0.
SHOULDER POINT FORCES (LB)					
LEFT X AXIS	-6.13	6.47	-562.02	256.	70.
LEFT Y AXIS	3.70	8.66	-37.39	265.	80.
LEFT Z AXIS	4.25	35.92	0.37	70.	272.
LEFT RESULTANT	8.42	563.99	2.72	71.	447.
RIGHT X AXIS	-7.43	11.36	-524.59	271.	70.
RIGHT Y AXIS	1.79	61.60	-2.66	67.	270.
RIGHT Z AXIS	0.93	24.16	-3.76	36.	271.
RIGHT RESULTANT	7.75	587.90	0.65	70.	208.
SHOULDER ROLLER					
Y AXIS FORCE (LB)	0.10	35.42	-12.54	67.	180.
Z AXIS FORCE (LB)	5.57	767.58	-10.55	68.	245.
X AXIS TORQUE (IN-LB)	-0.21	147.56	-13.66	107.	90.



CHIA STUDY -GX TEST: 3505 SUBJ: ADAM-L WT: 216.0 NOM G: 20.0 CELL: M

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
HARNES ANCHOR FORCES (LB)					
LEFT HORIZ X AXIS	-12.89	4.02	-1415.01	254.	80.
LEFT HORIZ Y AXIS	7.19	650.16	-3.43	76.	238.
LEFT HORIZ Z AXIS	10.85	792.87	-3.91	77.	271.
LEFT RESULTANT	18.53	1740.73	2.28	78.	243.
RIGHT HORIZ X AXIS	-12.43	0.13	-1437.74	267.	80.
RIGHT HORIZ Y AXIS	-5.39	2.90	-626.27	248.	74.
RIGHT HORIZ Z AXIS	12.34	1010.83	-3.65	74.	270.
RIGHT RESULTANT	18.51	1853.62	0.70	78.	274.
LEFT VERT X AXIS	2.29	12.02	-31.78	254.	63.
LEFT VERT Y AXIS	-0.04	17.95	-6.20	92.	54.
LEFT VERT Z AXIS	-11.93	12.41	-73.34	24.	90.
LEFT RESULTANT	12.16	80.48	3.93	91.	309.
RIGHT VERT X AXIS	0.20	18.06	-29.09	171.	37.
RIGHT VERT Y AXIS	-0.59	2.65	-21.49	60.	86.
RIGHT VERT Z AXIS	-2.95	16.60	-95.97	36.	91.
RIGHT RESULTANT	3.20	97.93	1.07	91.	320.
ADAM INTERNAL TEMP (DEG C)	84.38	84.79	83.79	190.	11.
ADAM ACCELERATIONS (G)					
HEAD X AXIS	0.24	7.19	-49.23	277.	90.
HEAD Z AXIS	0.88	5.91	-27.74	64.	96.
CHEST X AXIS	72.94	80.31	-36.25	160.	68.
LUMBAR X AXIS	0.39	8.98	-36.21	242.	62.
ADAM FORCES (LB)					
NECK X AXIS	-3.01	479.72	-76.57	90.	277.
NECK Z AXIS	-19.26	210.07	-84.97	101.	64.
LUMBAR X AXIS	23.22	256.99	-790.98	245.	91.
ADAM NECK MY TORQUE (IN-LB)	15.32	495.90	-171.80	85.	266.

CHIA STUDY -GX TEST: 3506 SUBJ: ADAM-S WT: 143.0 NOM G: 20.0 CELL: M

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK TIME (MS)				-102.	
2.5V EXT POWER (VOLTS)	2.50	2.50	2.50	427.	10.
10V EXT POWER (VOLTS)	10.00	10.00	10.00	0.	2.
SLED ACCELERATION (G)					
X AXIS	-0.06	0.65	-20.44	192.	80.
Y AXIS	-0.03	1.30	-0.52	276.	58.
Z AXIS	0.92	1.95	-1.14	35.	28.
SEAT ACCELERATION (G)					
X AXIS	0.42	1.66	-19.98	199.	60.
Y AXIS	-0.07	1.96	-2.56	39.	61.
Z AXIS	0.78	13.10	-0.04	80.	463.
RESULTANT	0.89	23.58	0.34	59.	255.
CHEST ACCELERATION (G)					
X AXIS	0.75	5.41	-25.95	245.	61.
Y AXIS	0.12	2.02	-5.12	229.	83.
Z AXIS	0.69	29.05	-5.49	56.	254.
RESULTANT	1.03	36.32	0.44	60.	309.
RY (RAD/SEC2)	-24.95	2041.38	-2039.55	257.	270.
SLED VELOCITY (FPS)	0.06	73.84	0.06	184.	0.
SHOULDER POINT FORCES (LB)					
LEFT X AXIS	1.12	11.29	-383.50	427.	89.
LEFT Y AXIS	7.08	13.81	-18.42	213.	57.
LEFT Z AXIS	7.36	39.39	4.98	69.	188.
LEFT RESULTANT	10.51	385.84	6.80	91.	246.
RIGHT X AXIS	-2.68	3.89	-417.24	202.	60.
RIGHT Y AXIS	1.11	29.33	-3.39	97.	224.
RIGHT Z AXIS	1.21	30.24	-2.74	34.	256.
RIGHT RESULTANT	3.47	418.32	0.25	60.	220.
SHOULDER ROLLER					
Y AXIS FORCE (LB)	-5.61	53.00	-12.72	59.	198.
Z AXIS FORCE (LB)	-0.67	553.00	-8.16	90.	248.
X AXIS TORQUE (IN-LB)	-4.52	166.79	-5.36	55.	0.

CHIA STUDY -GX TEST: 3506 SUBJ: ADAM-S WT: 143.0 NOM G: 20.0 CELL: M

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
HARNES ANCHOR FORCES (LB)					
LEFT HORIZ X AXIS	-10.17	-3.89	-995.96	4.	63.
LEFT HORIZ Y AXIS	6.47	489.74	-10.06	64.	244.
LEFT HORIZ Z AXIS	4.90	525.88	-6.52	64.	242.
LEFT RESULTANT	13.21	1228.14	3.98	64.	270.
RIGHT HORIZ X AXIS	-10.46	-2.01	-881.05	217.	65.
RIGHT HORIZ Y AXIS	-8.39	2.90	-364.71	231.	65.
RIGHT HORIZ Z AXIS	6.69	591.71	-3.45	65.	218.
RIGHT RESULTANT	15.18	1122.22	2.11	65.	217.
LEFT VERT X AXIS	0.10	7.40	-33.96	241.	60.
LEFT VERT Y AXIS	-1.14	14.11	-7.50	68.	34.
LEFT VERT Z AXIS	-5.97	20.25	-41.00	34.	69.
LEFT RESULTANT	6.10	53.61	0.23	69.	364.
RIGHT VERT X AXIS	-6.12	4.06	-35.84	171.	29.
RIGHT VERT Y AXIS	-1.11	4.86	-34.80	312.	73.
RIGHT VERT Z AXIS	-6.19	16.08	-106.14	35.	75.
RIGHT RESULTANT	8.89	112.08	4.54	76.	344.
ADAM INTERNAL TEMP (DEG C)	93.89	94.00	93.25	1.	15.
ADAM ACCELERATIONS (G)					
HEAD X AXIS	0.71	5.07	-43.72	248.	83.
HEAD Z AXIS	0.86	7.15	-20.51	39.	70.
CHEST X AXIS	-1.53	5.57	-30.72	241.	53.
LUMBAR X AXIS	1.08	8.04	-35.71	237.	58.
ADAM FORCES (LB)					
NECK X AXIS	-4.45	400.00	-43.69	82.	248.
NECK Z AXIS	-14.93	164.10	-71.65	94.	40.
LUMBAR X AXIS	7.48	206.43	-269.57	245.	80.
ADAM NECK MY TORQUE (IN-LB)	-13.44	346.99	-192.39	74.	55.

CHIA STUDY -GX TEST: 3507 SUBJ: ADAM-S WT: 143.0 NOM G: 20.0 CELL: M

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK TIME (MS)				-101.	
2.5V EXT POWER (VOLTS)	2.50	2.50	2.50	3.	38.
10V EXT POWER (VOLTS)	10.00	10.00	10.00	62.	4.
SLED ACCELERATION (G)					
X AXIS	-0.02	0.69	-20.10	179.	75.
Y AXIS	-0.03	1.00	-0.27	278.	358.
Z AXIS	0.90	1.71	-0.52	30.	37.
SEAT ACCELERATION (G)					
X AXIS	0.68	1.29	-18.75	266.	65.
Y AXIS	-0.07	1.52	-1.05	37.	66.
Z AXIS	0.78	12.17	0.05	79.	279.
RESULTANT	1.04	22.16	0.84	65.	208.
CHEST ACCELERATION (G)					
X AXIS	0.54	3.48	-28.35	234.	62.
Y AXIS	0.16	5.77	-11.19	72.	85.
Z AXIS	0.88	31.03	-3.17	52.	247.
RESULTANT	1.05	35.76	0.43	62.	308.
RY (RAD/SEC2)	-13.76	1040.87	-2336.98	261.	63.
SLED VELOCITY (FPS)	0.03	73.13	0.03	184.	0.
SHOULDER POINT FORCES (LB)					
LEFT X AXIS	6.55	10.50	-396.13	212.	92.
LEFT Y AXIS	4.02	6.77	-19.71	295.	90.
LEFT Z AXIS	1.84	32.46	0.34	91.	240.
LEFT RESULTANT	7.94	397.85	2.95	92.	189.
RIGHT X AXIS	-3.06	3.97	-413.19	267.	61.
RIGHT Y AXIS	1.38	22.46	-2.08	95.	283.
RIGHT Z AXIS	0.73	24.69	-1.95	33.	278.
RIGHT RESULTANT	3.68	414.03	0.64	61.	217.
SHOULDER ROLLER					
Y AXIS FORCE (LB)	-4.72	55.81	-11.69	60.	283.
Z AXIS FORCE (LB)	0.15	546.19	-7.48	88.	279.
X AXIS TORQUE (IN-LB)	-0.13	179.58	-80.01	50.	94.

CHIA STUDY -GX TEST: 3507 SUBJ: ADAM-S WT: 143.0 NOM G: 20.0 CELL: M

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
HARNES ANCHOR FORCES (LB)					
LEFT HORIZ X AXIS	-8.14	-1.38	-962.05	210.	63.
LEFT HORIZ Y AXIS	9.48	451.08	-3.29	64.	226.
LEFT HORIZ Z AXIS	7.98	509.87	-0.80	62.	219.
LEFT RESULTANT	15.03	1178.55	1.61	64.	219.
RIGHT HORIZ X AXIS	-7.37	-0.12	-778.71	213.	64.
RIGHT HORIZ Y AXIS	-7.36	-0.57	-346.96	216.	63.
RIGHT HORIZ Z AXIS	6.14	529.90	-1.01	64.	219.
RIGHT RESULTANT	12.28	1003.77	1.17	64.	219.
LEFT VERT X AXIS	2.72	9.93	-33.87	241.	63.
LEFT VERT Y AXIS	-1.46	17.90	-7.53	70.	46.
LEFT VERT Z AXIS	-9.81	20.50	-53.00	32.	69.
LEFT RESULTANT	10.33	63.83	1.19	69.	339.
RIGHT VERT X AXIS	-0.55	7.40	-32.50	171.	47.
RIGHT VERT Y AXIS	-0.69	5.35	-53.28	35.	78.
RIGHT VERT Z AXIS	-4.05	15.37	-151.87	30.	78.
RIGHT RESULTANT	4.46	161.10	0.74	78.	317.
ADAM INTERNAL TEMP (DEG C)	93.28	93.53	92.78	2.	369.
ADAM ACCELERATIONS (G)					
HEAD X AXIS	0.51	4.69	-46.08	253.	85.
HEAD Z AXIS	0.94	7.39	-25.60	41.	71.
CHEST X AXIS	-0.28	4.34	-30.19	241.	55.
LUMBAR X AXIS	0.41	6.03	-36.55	235.	58.
ADAM FORCES (LB)					
NECK X AXIS	-1.38	416.05	-39.01	84.	252.
NECK Z AXIS	-9.77	188.04	-82.79	94.	42.
LUMBAR X AXIS	7.31	182.14	-214.52	51.	80.
ADAM NECK MY TORQUE (IN-LB)	2.16	403.49	-194.10	79.	57.

CHIA STUDY -GX TEST: 3511 SUBJ: ADAM-S WT: 143.0 NOM G: 30.0 CELL: N

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK TIME (MS)				-169.	
2.5V EXT POWER (VOLTS)	2.50	2.50	2.50	412.	205.
10V EXT POWER (VOLTS)	10.00	10.00	10.00	0.	3.
SLED ACCELERATION (G)					
X AXIS	-0.02	0.90	-31.01	147.	68.
Y AXIS	-0.01	2.29	-1.44	244.	282.
Z AXIS	1.04	3.76	-2.32	31.	37.
SEAT ACCELERATION (G)					
X AXIS	0.49	1.64	-28.78	150.	68.
Y AXIS	-0.04	3.38	-1.92	73.	252.
Z AXIS	0.83	17.78	-0.19	54.	190.
RESULTANT	0.96	33.61	0.46	68.	418.
CHEST ACCELERATION (G)					
X AXIS	0.67	4.98	-43.47	208.	50.
Y AXIS	0.16	6.05	-12.76	71.	75.
Z AXIS	0.86	59.58	-7.50	47.	210.
RESULTANT	1.10	67.87	0.24	47.	265.
RY (RAD/SEC2)	-8.23	4378.99	-4806.94	66.	49.
SLED VELOCITY (FPS)	0.04	94.21	0.05	154.	0.
SHOULDER POINT FORCES (LB)					
LEFT X AXIS	-2.25	4.74	-686.14	187.	77.
LEFT Y AXIS	4.95	10.27	-31.17	182.	58.
LEFT Z AXIS	4.29	54.09	1.33	73.	242.
LEFT RESULTANT	7.14	688.74	1.87	78.	245.
RIGHT X AXIS	-2.00	7.78	-608.03	189.	79.
RIGHT Y AXIS	1.07	37.84	-4.23	78.	246.
RIGHT Z AXIS	2.05	43.03	-2.64	32.	221.
RIGHT RESULTANT	3.47	610.02	0.48	79.	225.
SHOULDER ROLLER					
Y AXIS FORCE (LB)	-0.19	65.26	-11.12	52.	438.
Z AXIS FORCE (LB)	2.34	900.61	-8.45	77.	232.
X AXIS TORQUE (IN-LB)	1.97	64.92	-129.08	55.	71.

CHIA STUDY -GX TEST: 3511 SUBJ: ADAM-S WT: 143.0 NOM G: 30.0 CELL: N

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
HARNES ANCHOR FORCES (LB)					
LEFT HORIZ X AXIS	-7.45	-2.14	-1119.78	0.	55.
LEFT HORIZ Y AXIS	7.89	584.31	-2.87	53.	194.
LEFT HORIZ Z AXIS	5.72	606.93	-1.52	53.	194.
LEFT RESULTANT	12.51	1398.30	2.70	55.	361.
RIGHT HORIZ X AXIS	-8.01	5.27	-1187.71	185.	55.
RIGHT HORIZ Y AXIS	-7.34	14.14	-530.20	186.	79.
RIGHT HORIZ Z AXIS	10.08	814.90	-3.45	54.	406.
RIGHT RESULTANT	14.95	1521.88	1.01	55.	337.
LEFT VERT X AXIS	0.38	7.49	-55.77	145.	52.
LEFT VERT Y AXIS	0.31	43.10	-9.03	74.	349.
LEFT VERT Z AXIS	-7.69	32.67	-106.17	31.	73.
LEFT RESULTANT	7.78	123.97	0.23	73.	307.
RIGHT VERT X AXIS	-3.07	14.51	-43.53	148.	33.
RIGHT VERT Y AXIS	-0.60	6.83	-36.28	34.	69.
RIGHT VERT Z AXIS	-4.37	21.48	-81.43	30.	71.
RIGHT RESULTANT	5.57	94.29	1.03	71.	395.
ADAM INTERNAL TEMP (DEG C)	82.43	83.12	81.63	412.	53.
ADAM ACCELERATIONS (G)					
HEAD X AXIS	0.79	6.26	-61.57	216.	72.
HEAD Z AXIS	0.76	14.32	-46.72	45.	74.
CHEST X AXIS	-0.45	5.37	-50.42	203.	46.
LUMBAR X AXIS	0.67	109.24	-54.82	31.	46.
ADAM FORCES (LB)					
NECK X AXIS	-1.13	560.70	-55.26	72.	242.
NECK Z AXIS	2.13	405.57	-88.38	76.	46.
LUMBAR X AXIS	19.86	266.40	-566.60	45.	71.
ADAM NECK MY TORQUE (IN-LB)	-10.60	692.50	-331.93	65.	50.

CHIA STUDY -GX TEST: 3512 SUBJ: ADAM-L WT: 216.0 NOM G: 30.0 CELL: N

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK TIME (MS)				-150.	
2.5V EXT POWER (VOLTS)	2.50	2.51	2.50	326.	0.
10V EXT POWER (VOLTS)	10.00	10.00	10.00	111.	342.
SLED ACCELERATION (G)					
X AXIS	-0.04	1.00	-30.40	148.	72.
Y AXIS	-0.01	2.51	-0.98	245.	46.
Z AXIS	0.98	3.97	-2.62	30.	36.
SEAT ACCELERATION (G)					
X AXIS	0.50	2.26	-30.29	216.	64.
Y AXIS	-0.04	4.03	-2.82	69.	221.
Z AXIS	0.84	18.14	-0.63	65.	246.
RESULTANT	0.98	35.27	0.21	64.	422.
CHEST ACCELERATION (G)					
X AXIS	0.53	16.53	-49.77	211.	59.
Y AXIS	0.15	55.48	-25.73	61.	66.
Z AXIS	0.94	50.63	-12.47	59.	216.
RESULTANT	1.09	83.57	0.41	60.	317.
RY (RAD/SEC2)	-1.08	7384.81	-11078.75	67.	61.
SLED VELOCITY (FPS)	0.02	93.08	0.04	160.	1.
SHOULDER POINT FORCES (LB)					
LEFT X AXIS	-8.36	7.58	-963.59	217.	76.
LEFT Y AXIS	2.14	16.00	-73.79	233.	58.
LEFT Z AXIS	2.67	55.70	-1.65	76.	228.
LEFT RESULTANT	9.05	967.78	0.72	78.	214.
RIGHT X AXIS	-8.28	11.28	-731.66	217.	60.
RIGHT Y AXIS	1.17	60.90	-9.21	65.	220.
RIGHT Z AXIS	0.46	40.42	-3.98	31.	148.
RIGHT RESULTANT	8.41	734.39	0.68	62.	176.
SHOULDER ROLLER					
Y AXIS FORCE (LB)	0.94	43.90	-46.68	47.	84.
Z AXIS FORCE (LB)	7.18	1110.63	-15.41	60.	214.
X AXIS TORQUE (IN-LB)	-0.23	89.08	-421.90	38.	65.



CHIA STUDY -GX TEST: 3512 SUBJ: ADAM-L WT: 216.0 NOM G: 30.0 CELL: N

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
HARNESS ANCHOR FORCES (LB)					
LEFT HORIZ X AXIS	-12.17	-5.65	-2435.58	216.	67.
LEFT HORIZ Y AXIS	10.07	1016.80	-7.27	66.	219.
LEFT HORIZ Z AXIS	11.96	1285.28	-0.43	66.	195.
LEFT RESULTANT	19.91	2934.42	5.68	67.	378.
RIGHT HORIZ X AXIS	-13.68	-0.88	-2342.91	393.	72.
RIGHT HORIZ Y AXIS	-3.73	3.75	-886.99	235.	62.
RIGHT HORIZ Z AXIS	11.76	1565.48	-0.20	63.	244.
RIGHT RESULTANT	18.51	2908.46	3.31	71.	398.
LEFT VERT X AXIS	2.29	17.08	-53.48	217.	61.
LEFT VERT Y AXIS	-0.13	22.76	-14.11	135.	255.
LEFT VERT Z AXIS	-7.93	32.59	-81.75	29.	136.
LEFT RESULTANT	8.28	84.66	2.39	136.	5.
RIGHT VERT X AXIS	3.35	21.76	-50.78	214.	64.
RIGHT VERT Y AXIS	0.35	8.24	-22.80	33.	72.
RIGHT VERT Z AXIS	-5.87	29.01	-80.34	55.	144.
RIGHT RESULTANT	6.93	86.19	3.18	76.	3.
ADAM INTERNAL TEMP (DEG C)	75.26	204.96	37.53	94.	98.
ADAM ACCELERATIONS (G)					
HEAD X AXIS	0.13	9.76	-72.66	217.	78.
HEAD Z AXIS	0.88	13.97	-58.38	50.	64.
CHEST X AXIS	-0.20	21.17	-43.09	209.	50.
LUMBAR X AXIS	0.34	12.41	-61.46	211.	49.
ADAM FORCES (LB)					
NECK X AXIS	-4.75	691.87	-132.20	77.	243.
NECK Z AXIS	-7.72	377.62	-139.73	87.	51.
LUMBAR X AXIS	8.47	329.06	-1476.67	213.	76.
ADAM NECK MY TORQUE (IN-LB)	0.85	824.43	-280.59	72.	233.

CHIA STUDY -GX TEST: 3513 SUBJ: ADAM-S WT: 143.0 NOM G: 40.0 CELL: 0

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK TIME (MS)				-182.	
2.5V EXT POWER (VOLTS)	2.50	2.50	2.46	27.	31.
10V EXT POWER (VOLTS)	10.00	10.00	10.00	0.	30.
SLED ACCELERATION (G)					
X AXIS	-0.01	0.81	-42.11	350.	63.
Y AXIS	-0.02	2.09	-1.18	319.	350.
Z AXIS	0.97	4.65	-2.77	25.	31.
SEAT ACCELERATION (G)					
X AXIS	0.54	2.60	-38.57	130.	68.
Y AXIS	-0.05	3.44	-2.00	69.	368.
Z AXIS	0.83	24.86	-0.69	58.	131.
RESULTANT	0.99	44.83	0.68	68.	166.
CHEST ACCELERATION (G)					
X AXIS	0.66	25.17	-50.13	186.	74.
Y AXIS	0.17	7.27	-12.53	199.	52.
Z AXIS	0.88	60.65	-13.24	42.	189.
RESULTANT	1.12	71.62	0.36	43.	268.
RY (RAD/SEC2)	-1.04	5674.18	-7332.85	186.	75.
SLED VELOCITY (FPS)	0.03	108.57	-0.02	140.	0.
SHOULDER POINT FORCES (LB)					
LEFT X AXIS	1.53	10.18	-862.29	358.	69.
LEFT Y AXIS	2.79	7.53	-54.64	195.	61.
LEFT Z AXIS	2.23	67.60	-1.22	60.	130.
LEFT RESULTANT	4.19	866.32	1.74	70.	163.
RIGHT X AXIS	-1.24	11.44	-795.07	358.	70.
RIGHT Y AXIS	0.66	54.05	-4.37	74.	203.
RIGHT Z AXIS	0.94	47.83	-4.19	26.	130.
RIGHT RESULTANT	2.18	797.91	0.68	72.	178.
SHOULDER ROLLER					
Y AXIS FORCE (LB)	1.28	88.45	-9.24	42.	158.
Z AXIS FORCE (LB)	1.14	1167.05	-7.63	69.	163.
X AXIS TORQUE (IN-LB)	3.15	132.31	-157.34	37.	64.

CHIA STUDY -GX TEST: 3513 SUBJ: ADAM-S WT: 143.0 NOM G: 40.0 CELL: 0

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
HARNES ANCHOR FORCES (LB)					
LEFT HORIZ X AXIS	-8.17	4.14	-1741.39	324.	68.
LEFT HORIZ Y AXIS	7.75	723.98	-6.50	48.	207.
LEFT HORIZ Z AXIS	7.39	916.45	-3.48	70.	180.
LEFT RESULTANT	13.56	2091.21	2.20	68.	172.
RIGHT HORIZ X AXIS	-10.98	6.41	-1695.17	356.	50.
RIGHT HORIZ Y AXIS	-11.83	3.53	-731.68	360.	71.
RIGHT HORIZ Z AXIS	12.28	1152.79	-3.72	48.	376.
RIGHT RESULTANT	20.47	2164.38	0.36	50.	334.
LEFT VERT X AXIS	2.24	11.97	-78.05	186.	67.
LEFT VERT Y AXIS	-0.63	56.09	-8.75	63.	396.
LEFT VERT Z AXIS	-4.82	36.01	-119.15	25.	63.
LEFT RESULTANT	5.39	151.86	1.35	63.	412.
RIGHT VERT X AXIS	0.47	23.07	-71.23	185.	58.
RIGHT VERT Y AXIS	-0.56	6.93	-77.56	29.	64.
RIGHT VERT Z AXIS	-4.18	32.80	-192.33	25.	63.
RIGHT RESULTANT	4.64	214.38	1.46	63.	418.
ADAM INTERNAL TEMP (DEG C)	63.28	63.66	62.66	42.	374.
ADAM ACCELERATIONS (G)					
HEAD X AXIS	0.65	9.01	-92.34	217.	66.
HEAD Z AXIS	0.78	25.07	-72.12	40.	55.
CHEST X AXIS	-1.03	12.59	-62.80	179.	41.
LUMBAR X AXIS	0.78	15.21	-73.89	180.	40.
ADAM FORCES (LB)					
NECK X AXIS	-3.80	862.43	-78.56	65.	218.
NECK Z AXIS	-17.51	604.13	-191.52	67.	40.
LUMBAR X AXIS	-2.10	274.65	-1129.55	184.	63.
ADAM NECK MY TORQUE (IN-LB)	-3.89	830.26	-446.41	60.	45.

CHIA STUDY -GX TEST: 3514 SUBJ: ADAM-S WT: 143.0 NOM G: 45.0 CELL: P

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK TIME (MS)				-237.	
2.5V EXT POWER (VOLTS)	2.50	2.50	2.49	278.	199.
10V EXT POWER (VOLTS)	10.00	10.00	10.00	178.	86.
SLED ACCELERATION (G)					
X AXIS	-0.02	0.75	-43.82	354.	62.
Y AXIS	-0.01	2.13	-0.73	188.	47.
Z AXIS	0.95	5.01	-3.10	26.	32.
SEAT ACCELERATION (G)					
X AXIS	0.50	2.81	-41.90	127.	66.
Y AXIS	-0.08	4.23	-1.47	68.	61.
Z AXIS	0.82	25.69	-0.69	57.	129.
RESULTANT	0.96	48.43	0.33	67.	353.
CHEST ACCELERATION (G)					
X AXIS	0.50	18.05	-65.95	188.	44.
Y AXIS	0.11	2.84	-14.89	64.	68.
Z AXIS	0.87	66.29	-12.08	43.	190.
RESULTANT	1.01	90.90	0.28	43.	212.
RY (RAD/SEC2)	-17.58	8484.07	-10560.30	61.	65.
SLED VELOCITY (FPS)	0.01	111.93	-0.01	132.	0.
SHOULDER POINT FORCES (LB)					
LEFT X AXIS	-0.57	7.03	-861.51	147.	69.
LEFT Y AXIS	5.78	9.32	-34.42	340.	54.
LEFT Z AXIS	5.69	82.58	2.29	69.	130.
LEFT RESULTANT	8.35	865.73	2.76	69.	354.
RIGHT X AXIS	-2.90	4.13	-889.79	145.	70.
RIGHT Y AXIS	1.19	53.77	-3.48	72.	165.
RIGHT Z AXIS	1.34	53.31	-3.78	27.	214.
RIGHT RESULTANT	3.67	892.72	0.16	70.	193.
SHOULDER ROLLER					
Y AXIS FORCE (LB)	-1.67	81.81	-10.55	46.	138.
Z AXIS FORCE (LB)	0.23	1156.50	-10.70	69.	242.
X AXIS TORQUE (IN-LB)	1.17	275.05	-6.39	53.	199.

CHIA STUDY -GZ TEST: 3514 SUBJ: ADAM-S WT: 143.0 NOM G: 45.0 CELL: P

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
HARNES ANCHOR FORCES (LB)					
LEFT HORIZ X AXIS	-7.15	5.65	-1965.92	349.	63.
LEFT HORIZ Y AXIS	6.41	842.95	-6.36	47.	171.
LEFT HORIZ Z AXIS	6.27	1070.37	-5.29	47.	339.
LEFT RESULTANT	11.76	2339.82	1.89	63.	333.
RIGHT HORIZ X AXIS	-7.28	-1.00	-1790.49	160.	63.
RIGHT HORIZ Y AXIS	-10.11	0.49	-706.44	178.	68.
RIGHT HORIZ Z AXIS	7.55	1170.17	-3.25	67.	172.
RIGHT RESULTANT	14.61	2241.19	1.13	64.	335.
LEFT VERT X AXIS	1.36	15.86	-83.89	183.	63.
LEFT VERT Y AXIS	-1.05	47.06	-10.14	64.	360.
LEFT VERT Z AXIS	-5.75	34.30	-112.70	25.	182.
LEFT RESULTANT	6.14	132.86	2.99	63.	4.
RIGHT VERT X AXIS	-2.94	17.84	-61.95	184.	66.
RIGHT VERT Y AXIS	-0.11	4.86	-84.80	28.	63.
RIGHT VERT Z AXIS	-2.43	34.80	-212.85	26.	62.
RIGHT RESULTANT	4.35	235.56	0.72	63.	1.
ADAM INTERNAL TEMP (DEG C)	74.55	76.86	73.12	38.	42.
ADAM ACCELERATIONS (G)					
HEAD X AXIS	0.68	14.38	-104.43	233.	66.
HEAD Z AXIS	0.77	21.45	-84.24	40.	56.
CHEST X AXIS	-0.31	12.64	-70.62	178.	41.
LUMBAR X AXIS	0.67	16.01	-78.22	179.	40.
ADAM FORCES (LB)					
NECK X AXIS	-1.07	985.49	-72.52	66.	216.
NECK Z AXIS	-32.17	801.26	-81.39	69.	32.
LUMBAR X AXIS	-0.15	301.62	-1197.78	183.	69.
ADAM NECK MY TORQUE (IN-LB)	-7.39	927.50	-613.03	61.	47.

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CHIA STUDY -GX TEST: 3515 SUBJ: ADAM-S WT: 143.0 NOM G: 20.0 CELL: H

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK TIME (MS)				-162.	
2.5V EXT POWER (VOLTS)	2.50	2.51	2.50	70.	357.
10V EXT POWER (VOLTS)	10.00	10.00	10.00	70.	71.
SLED ACCELERATION (G)					
X AXIS	-0.01	0.55	-20.09	179.	74.
Y AXIS	-0.04	1.32	-0.59	250.	164.
Z AXIS	0.97	1.94	-0.54	30.	37.
SEAT ACCELERATION (G)					
X AXIS	0.51	1.15	-18.46	309.	78.
Y AXIS	-0.04	1.28	-0.88	37.	221.
Z AXIS	0.82	12.75	0.33	57.	179.
RESULTANT	0.97	21.75	0.73	79.	180.
CHEST ACCELERATION (G)					
X AXIS	0.54	17.96	-32.81	242.	58.
Y AXIS	0.23	9.36	-10.59	72.	67.
Z AXIS	0.88	17.98	-4.11	55.	248.
RESULTANT	1.06	37.01	0.07	57.	337.
RY (RAD/SEC2)	-3.24	2001.96	-2705.64	51.	46.
SLED VELOCITY (FPS)	0.02	76.00	-0.01	182.	1.
SHOULDER POINT FORCES (LB)					
LEFT X AXIS	-4.47	2.37	-388.47	252.	65.
LEFT Y AXIS	2.09	6.61	-24.47	232.	66.
LEFT Z AXIS	1.13	34.57	-2.13	64.	403.
LEFT RESULTANT	5.21	390.70	1.62	65.	216.
RIGHT X AXIS	-1.43	4.53	-396.74	270.	91.
RIGHT Y AXIS	0.40	17.97	-5.40	101.	219.
RIGHT Z AXIS	0.70	25.78	-2.13	33.	181.
RIGHT RESULTANT	2.33	397.61	0.82	91.	0.
SHOULDER ROLLER					
Y AXIS FORCE (LB)	-0.71	52.50	-7.89	102.	218.
Z AXIS FORCE (LB)	1.53	548.43	-5.24	89.	225.
X AXIS TORQUE (IN-LB)	-2.46	86.35	-63.94	105.	70.

CHIA STUDY -GX TEST: 3515 SUBJ: ADAM-S WT: 143.0 NOM G: 20.0 CELL: H

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
HARNES ANCHOR FORCES (LB)					
LEFT HORIZ X AXIS	-1.48	11.80	-867.24	233.	66.
LEFT HORIZ Y AXIS	-1.21	141.55	-8.74	69.	220.
LEFT HORIZ Z AXIS	1.70	60.48	-4.71	63.	213.
LEFT RESULTANT	3.89	879.56	2.19	67.	212.
RIGHT HORIZ X AXIS	-4.82	25.37	-979.26	249.	64.
RIGHT HORIZ Y AXIS	-0.36	6.43	-202.11	231.	59.
RIGHT HORIZ Z AXIS	1.48	87.58	-7.10	113.	433.
RIGHT RESULTANT	5.73	1000.55	0.76	65.	205.
LEFT VERT X AXIS	-0.47	3.55	-159.46	355.	68.
LEFT VERT Y AXIS	-0.05	77.55	-3.81	95.	269.
LEFT VERT Z AXIS	-10.20	12.41	-236.67	23.	93.
LEFT RESULTANT	10.28	289.01	1.13	94.	368.
RIGHT VERT X AXIS	-0.36	3.26	-130.93	252.	63.
RIGHT VERT Y AXIS	-0.86	3.52	-39.59	34.	63.
RIGHT VERT Z AXIS	-7.54	11.39	-159.07	23.	64.
RIGHT RESULTANT	7.64	209.48	1.52	64.	378.
ADAM INTERNAL TEMP (DEG C)	66.82	67.92	66.42	70.	74.
ADAM ACCELERATIONS (G)					
HEAD X AXIS	0.74	6.49	-42.50	250.	84.
HEAD Z AXIS	0.60	4.03	-27.77	33.	70.
CHEST X AXIS	-0.08	7.80	-30.36	243.	54.
LUMBAR X AXIS	0.92	6.02	-37.44	242.	56.
ADAM FORCES (LB)					
NECK X AXIS	-6.37	372.24	-63.32	85.	248.
NECK Z AXIS	-12.11	151.69	-105.10	98.	76.
LUMBAR X AXIS	-4.13	138.67	-559.46	249.	88.
ADAM NECK NY TORQUE (IN-LB)	-8.07	139.38	-202.09	89.	57.

CHIA STUDY -GX TEST: 3516 SUBJ: ADAM-S WT: 143.0 NOM G: 20.0 CELL: H

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK TIME (MS)				-164.	
2.5V EXT POWER (VOLTS)	2.50	2.50	2.50	234.	387.
10V EXT POWER (VOLTS)	10.00	10.00	10.00	2.	160.
SLED ACCELERATION (G)					
X AXIS	-0.04	0.62	-20.36	178.	79.
Y AXIS	-0.02	0.81	-0.27	280.	236.
Z AXIS	0.96	1.91	-0.40	40.	46.
SEAT ACCELERATION (G)					
X AXIS	0.50	1.29	-18.76	267.	76.
Y AXIS	-0.07	1.26	-1.01	100.	290.
Z AXIS	0.83	12.46	0.22	74.	179.
RESULTANT	0.98	22.43	0.66	76.	222.
CHEST ACCELERATION (G)					
X AXIS	0.56	22.79	-32.95	240.	50.
Y AXIS	0.15	6.29	-7.52	94.	85.
Z AXIS	0.82	22.21	-4.19	57.	254.
RESULTANT	1.00	35.97	0.19	58.	296.
RY (RAD/SEC2)	-7.34	2522.23	-3316.42	54.	49.
SLED VELOCITY (FPS)	0.02	77.11	0.05	185.	0.
SHOULDER POINT FORCES (LB)					
LEFT X AXIS	-3.49	7.89	-442.16	381.	89.
LEFT Y AXIS	2.71	6.47	-28.07	275.	61.
LEFT Z AXIS	3.20	37.78	1.08	83.	180.
LEFT RESULTANT	5.61	444.66	2.15	89.	260.
RIGHT X AXIS	-2.62	7.47	-369.97	227.	61.
RIGHT Y AXIS	0.51	23.30	-2.41	100.	264.
RIGHT Z AXIS	0.55	27.00	-2.18	40.	343.
RIGHT RESULTANT	3.00	371.28	0.60	62.	247.
SHOULDER ROLLER					
Y AXIS FORCE (LB)	-1.74	49.77	-7.07	123.	263.
Z AXIS FORCE (LB)	0.94	538.78	-7.41	61.	286.
X AXIS TORQUE (IN-LB)	-3.12	95.15	-101.59	111.	90.



CHIA STUDY -GX TEST: 3516 SUBJ: ADAM-S WT: 143.0 NOM G: 20.0 CELL: H

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
HARNES ANCHOR FORCES (LB)					
LEFT HORIZ X AXIS	-3.26	28.38	-894.62	240.	64.
LEFT HORIZ Y AXIS	-1.33	161.19	-6.57	64.	265.
LEFT HORIZ Z AXIS	-0.20	65.41	-3.40	64.	206.
LEFT RESULTANT	4.55	911.37	3.05	64.	0.
RIGHT HORIZ X AXIS	-2.13	16.95	-1006.51	230.	62.
RIGHT HORIZ Y AXIS	-0.41	10.60	-148.46	190.	63.
RIGHT HORIZ Z AXIS	-0.45	71.08	-6.70	121.	404.
RIGHT RESULTANT	2.64	1019.02	1.89	63.	0.
LEFT VERT X AXIS	-1.26	0.05	-172.70	0.	64.
LEFT VERT Y AXIS	-0.63	66.99	-2.92	65.	399.
LEFT VERT Z AXIS	-5.47	17.15	-203.35	30.	64.
LEFT RESULTANT	5.82	274.77	0.90	64.	430.
RIGHT VERT X AXIS	-3.42	3.55	-116.14	236.	62.
RIGHT VERT Y AXIS	-0.56	1.76	-37.90	25.	73.
RIGHT VERT Z AXIS	-9.91	10.87	-143.51	27.	69.
RIGHT RESULTANT	10.60	185.27	1.23	69.	435.
ADAM INTERNAL TEMP (DEG C)	59.70	59.83	59.08	6.	184.
ADAM ACCELERATIONS (G)					
HEAD X AXIS	0.69	6.85	-39.56	247.	83.
HEAD Z AXIS	0.87	4.21	-21.47	36.	93.
CHEST X AXIS	-0.67	8.89	-29.99	240.	54.
LUMBAR X AXIS	0.86	7.51	-39.71	233.	58.
ADAM FORCES (LB)					
NECK X AXIS	-1.47	360.89	-55.16	83.	246.
NECK Z AXIS	-6.34	353.65	-39.26	96.	43.
LUMBAR X AXIS	-5.64	158.83	-340.97	244.	82.
ADAM NECK MY TORQUE (IN-LB)	-4.33	85.37	-225.06	73.	56.

CHIA STUDY -GX TEST: 3517 SUBJ: ADAM-L WT: 216.0 NOM G: 30.0 CELL: I

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK TIME (MS)				-207.	
2.5V EXT POWER (VOLTS)	2.50	2.50	2.50	32.	207.
10V EXT POWER (VOLTS)	10.00	10.00	10.00	199.	77.
SLED ACCELERATION (G)					
X AXIS	-0.03	0.90	-29.85	149.	73.
Y AXIS	-0.02	2.46	-1.37	260.	309.
Z AXIS	0.95	4.25	-2.83	31.	37.
SEAT ACCELERATION (G)					
X AXIS	0.52	1.87	-28.91	225.	64.
Y AX.	-0.04	3.17	-2.10	71.	19.
Z AXI	0.81	18.03	-0.77	64.	2.
RESULTANT	0.96	34.17	0.26	64.	202.
CHEST ACCELERATION (G)					
X AXIS	0.70	33.93	-51.93	213.	64.
Y AXIS	0.24	32.54	-21.57	58.	54.
Z AXIS	0.78	58.40	-16.32	62.	211.
RESULTANT	1.08	72.76	0.32	62.	188.
RY (RAD/SEC2)	-3.95	6989.25	-8111.74	218.	238.
SLED VELOCITY (FPS)	0.02	93.85	0.00	158.	1.
SHOULDER POINT FORCES (LB)					
LEFT X AXIS	-9.57	3.95	-939.59	189.	77.
LEFT Y AXIS	2.45	9.49	-66.49	227.	59.
LEFT Z AXIS	2.69	56.25	-2.25	77.	231.
LEFT RESULTANT	10.28	942.88	1.48	78.	214.
RIGHT X AXIS	-8.91	6.83	-819.55	232.	61.
RIGHT Y AXIS	1.15	70.27	-5.68	70.	261.
RIGHT Z AXIS	0.43	39.86	-5.81	32.	231.
RIGHT RESULTANT	9.02	822.07	1.34	62.	176.
SHOULDER ROLLER					
Y AXIS FORCE (LB)	1.42	46.71	-20.78	43.	82.
Z AXIS FORCE (LB)	11.08	1185.90	-11.22	60.	203.
X AXIS TORQUE (IN-LB)	-1.03	141.16	-102.03	43.	75.

CHIA STUDY -GX TEST: 3517 SUBJ: ADAM-L WT: 216.0 NOM G: 30.0 CELL: I

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
HARNES ANCHOR FORCES (LB)					
LEFT HORIZ X AXIS	-1.08	50.35	-2856.77	235.	68.
LEFT HORIZ Y AXIS	-9.93	150.85	-76.33	96.	67.
LEFT HORIZ Z AXIS	-1.72	110.97	-4.92	65.	1.
LEFT RESULTANT	10.44	2859.81	1.42	68.	275.
RIGHT HORIZ X AXIS	-10.30	52.49	-2703.94	223.	70.
RIGHT HORIZ Y AXIS	10.05	21.06	-166.27	17.	83.
RIGHT HORIZ Z AXIS	-6.71	70.81	-34.02	55.	88.
RIGHT RESULTANT	15.93	2704.61	2.27	70.	282.
LEFT VERT X AXIS	-1.64	-1.17	-341.79	0.	66.
LEFT VERT Y AXIS	-1.80	169.86	-10.65	69.	223.
LEFT VERT Z AXIS	-11.94	16.33	-481.83	22.	68.
LEFT RESULTANT	12.22	614.34	8.94	68.	395.
RIGHT VERT X AXIS	-3.28	3.70	-282.83	221.	69.
RIGHT VERT Y AXIS	1.59	12.00	-81.12	227.	72.
RIGHT VERT Z AXIS	-10.63	22.64	-405.12	29.	72.
RIGHT RESULTANT	11.30	498.65	7.15	72.	394.
ADAM INTERNAL TEMP (DEG C)	77.97	78.74	77.50	36.	138.
ADAM ACCELERATIONS (G)					
HEAD X AXIS	0.62	11.71	-75.55	241.	78.
HEAD Z AXIS	0.81	5.43	-52.61	43.	67.
CHEST X AXIS	0.63	22.26	-54.83	209.	59.
LUMBAR X AXIS	0.66	7.06	-36.73	211.	67.
ADAM FORCES (LB)					
NECK X AXIS	-15.27	725.19	-119.61	78.	241.
NECK Z AXIS	-201.80	260.07	-258.65	62.	40.
LUMBAR X AXIS	29.30	281.99	-1959.05	215.	77.
ADAM NECK MY TORQUE (IN-LB)	45.43	820.06	-304.49	72.	229.

CHIA STUDY -GX TEST: 3518 SUBJ: ADAM-L WT: 216.0 NOM G: 30.0 CELL: I

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK TIME (MS)				-209.	
2.5V EXT POWER (VOLTS)	2.50	2.51	2.50	214.	241.
10V EXT POWER (VOLTS)	10.00	10.00	10.00	19.	148.
SLED ACCELERATION (G)					
X AXIS	-0.02	1.03	-30.03	148.	73.
Y AXIS	-0.03	2.22	-1.46	252.	294.
Z AXIS	0.97	4.29	-2.74	32.	38.
SEAT ACCELERATION (G)					
X AXIS	0.48	2.22	-28.21	224.	65.
Y AXIS	-0.07	3.88	-2.64	72.	51.
Z AXIS	0.81	18.33	-0.22	32.	149.
RESULTANT	0.95	33.71	0.16	65.	231.
CHEST ACCELERATION (G)					
X AXIS	1.21	18.19	-58.04	215.	54.
Y AXIS	0.24	42.81	-26.49	60.	54.
Z AXIS	0.57	50.51	-21.89	58.	212.
RESULTANT	1.37	76.05	0.63	54.	194.
RY (RAD/SEC2)	-7.62	8666.87	-11355.70	228.	211.
SLED VELOCITY (FPS)	0.00	94.01	-0.03	150.	0.
SHOULDER POINT FORCES (LB)					
LEFT X AXIS	-8.88	8.13	-998.57	215.	78.
LEFT Y AXIS	1.71	8.13	-67.85	183.	59.
LEFT Z AXIS	2.33	58.17	-1.47	65.	184.
LEFT RESULTANT	9.37	1002.06	0.86	79.	198.
RIGHT X AXIS	-11.21	8.66	-841.56	215.	82.
RIGHT Y AXIS	1.64	84.83	-7.48	65.	266.
RIGHT Z AXIS	0.96	40.93	-4.75	32.	148.
RIGHT RESULTANT	11.39	845.05	0.91	82.	199.
SHOULDER ROLLER					
Y AXIS FORCE (LB)	4.16	92.22	-17.90	50.	79.
Z AXIS FORCE (LB)	10.99	1183.66	-9.73	79.	229.
X AXIS TORQUE (IN-LB)	4.86	239.86	-156.35	50.	74.

CHIA STUDY -GX TEST: 3518 SUBJ: ADAM-L WT: 216.0 NOM G: 30.0 CELL: I

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
HARNES ANCHOR FORCES (LB)					
LEFT HORIZ X AXIS	-5.88	57.39	-2636.25	225.	71.
LEFT HORIZ Y AXIS	-10.90	146.37	-35.37	94.	71.
LEFT HORIZ Z AXIS	0.62	114.01	-5.51	68.	292.
LEFT RESULTANT	12.59	2638.80	1.99	71.	207.
RIGHT HORIZ X AXIS	-1.37	77.35	-2836.05	218.	73.
RIGHT HORIZ Y AXIS	34.20	40.86	-157.08	21.	91.
RIGHT HORIZ Z AXIS	-14.18	91.30	-23.67	57.	76.
RIGHT RESULTANT	37.20	2836.45	2.54	73.	197.
LEFT VERT X AXIS	-1.68	2.53	-406.22	224.	69.
LEFT VERT Y AXIS	-1.66	209.81	-12.66	70.	270.
LEFT VERT Z AXIS	-13.29	17.97	-582.28	24.	71.
LEFT RESULTANT	13.56	740.33	6.67	71.	399.
RIGHT VERT X AXIS	-2.04	8.70	-237.93	217.	68.
RIGHT VERT Y AXIS	0.07	12.14	-74.08	43.	74.
RIGHT VERT Z AXIS	-4.08	27.34	-355.39	31.	73.
RIGHT RESULTANT	4.69	424.38	2.71	74.	4.
ADAM INTERNAL TEMP (DEG C)	83.95	85.45	83.70	188.	6.
ADAM ACCELERATIONS (G)					
HEAD X AXIS	1.12	12.80	-81.32	216.	78.
HEAD Z AXIS	0.99	8.40	-67.78	50.	65.
CHEST X AXIS	0.89	27.63	-46.18	209.	63.
LUMBAR X AXIS	0.90	8.89	-49.68	211.	49.
ADAM FORCES (LB)					
NECK X AXIS	-7.33	808.10	-121.17	79.	241.
NECK Z AXIS	16.87	1176.29	-473.19	67.	76.
LUMBAR X AXIS	9.35	291.50	-2183.32	214.	79.
ADAM NECK MY TORQUE (IN-LB)	18.38	1073.24	-351.97	73.	229.

CHIA STUDY -GX TEST: 3519 SUBJ: ADAM-S WT: 143.0 NOM G: 30.0 CELL: I

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK TIME (MS)				-221.	
2.5V EXT POWER (VOLTS)	2.50	2.51	2.49	49.	35.
10V EXT POWER (VOLTS)	10.00	10.00	10.00	49.	50.
SLED ACCELERATION (G)					
X AXIS	-0.02	0.76	-30.40	148.	68.
Y AXIS	-0.01	1.16	-0.41	234.	228.
Z AXIS	1.00	3.98	-2.44	30.	36.
SEAT ACCELERATION (G)					
X AXIS	0.50	1.50	-27.33	152.	77.
Y AXIS	-0.04	1.98	-2.13	72.	220.
Z AXIS	0.84	19.39	0.19	66.	150.
RESULTANT	0.98	33.26	0.41	65.	188.
CHEST ACCELERATION (G)					
X AXIS	0.57	8.37	-38.21	201.	74.
Y AXIS	0.13	2.76	-15.12	209.	72.
Z AXIS	0.87	36.73	-8.60	81.	217.
RESULTANT	1.05	47.57	0.30	49.	162.
RY (RAD/SEC2)	-1.27	3574.11	-2860.63	80.	89.
SLED VELOCITY (FPS)	0.02	93.89	-0.03	148.	0.
SHOULDER POINT FORCES (LB)					
LEFT X AXIS	1.21	7.89	-596.13	217.	75.
LEFT Y AXIS	2.12	9.02	-37.02	230.	59.
LEFT Z AXIS	1.53	50.67	-2.09	54.	188.
LEFT RESULTANT	3.27	598.94	0.96	75.	345.
RIGHT X AXIS	-4.05	7.87	-647.67	295.	78.
RIGHT Y AXIS	0.74	44.38	-5.87	76.	349.
RIGHT Z AXIS	0.68	39.28	-3.86	31.	355.
RIGHT RESULTANT	4.30	649.83	0.10	78.	173.
SHOULDER ROLLER					
Y AXIS FORCE (LB)	-0.03	57.01	-12.26	39.	218.
Z AXIS FORCE (LB)	3.10	871.73	-7.41	73.	180.
X AXIS TORQUE (IN-LB)	6.83	228.05	-45.20	38.	235.

CHIA STUDY -GX TEST: 3519 SUBJ: ADAM-S WT: 143.0 NOM G: 30.0 CELL: I

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
HARNES ANCHOR FORCES (LD)					
LEFT HORIZ X AXIS	-3.70	26.25	-1687.89	221.	73.
LEFT HORIZ Y AXIS	-1.27	234.38	-13.77	110.	244.
LEFT HORIZ Z AXIS	-0.28	75.91	-7.39	30.	184.
LEFT RESULTANT	4.82	1688.24	1.16	73.	270.
RIGHT HORIZ X AXIS	-0.13	24.74	-1538.70	226.	72.
RIGHT HORIZ Y AXIS	1.29	8.77	-252.80	235.	83.
RIGHT HORIZ Z AXIS	-0.47	70.54	-7.24	31.	60.
RIGHT RESULTANT	1.98	1552.09	1.80	72.	0.
LEFT VERT X AXIS	-2.19	0.24	-153.04	216.	55.
LEFT VERT Y AXIS	1.22	77.55	-7.63	70.	354.
LEFT VERT Z AXIS	-16.97	16.17	-192.08	22.	70.
LEFT RESULTANT	17.18	250.51	4.95	71.	373.
RIGHT VERT X AXIS	0.05	3.12	-170.98	200.	67.
RIGHT VERT Y AXIS	-1.65	6.97	-65.46	33.	69.
RIGHT VERT Z AXIS	-14.84	22.51	-218.70	29.	67.
RIGHT RESULTANT	15.03	283.71	3.26	67.	375.
ADAM INTERNAL TEMP (DEG C)	83.37	84.61	82.85	49.	144.
ADAM ACCELERATIONS (G)					
HEAD X AXIS	0.40	34.67	-80.96	235.	75.
HEAD Z AXIS	0.92	7.12	-54.91	34.	61.
CHEST X AXIS	0.22	10.04	-39.11	205.	45.
LUMBAR X AXIS	0.53	5.65	-53.12	203.	50.
ADAM FORCES (LB)					
NECK X AXIS	3.37	780.03	-56.95	75.	214.
NECK Z AXIS	-15.15	446.57	-67.02	80.	33.
LUMBAR X AXIS	5.91	197.22	-1080.05	38.	77.
ADAM NECK MY TORQUE (IN-LB)	-4.57	348.70	-318.74	71.	51.

CHIA STUDY -GX TEST: 3520 SUBJ: ADAM-S WT: 143.0 NOM G: 30.0 CELL: I

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK TIME (MS)				-228.	
2.5V EXT POWER (VOLTS)	2.50	2.50	2.49	33.	742.
10V EXT POWER (VOLTS)	10.00	10.00	10.00	10.	30.
SLED ACCELERATION (G)					
X AXIS	-0.04	0.70	-30.15	150.	69.
Y AXIS	0.02	2.18	-1.06	250.	308.
Z AXIS	0.97	3.89	-2.31	32.	38.
SEAT ACCELERATION (G)					
X AXIS	0.49	1.56	-27.09	152.	73.
Y AXIS	-0.06	2.73	-1.20	87.	259.
Z AXIS	0.82	19.09	0.11	66.	195.
RESULTANT	0.96	32.72	0.78	66.	324.
CHEST ACCELERATION (G)					
X AXIS	0.48	17.26	-45.00	203.	48.
Y AXIS	0.11	4.80	-11.86	227.	73.
Z AXIS	0.96	30.56	-4.81	42.	221.
RESULTANT	1.08	53.86	0.41	49.	296.
RY (RAD/SEC2)	-12.20	1853.08	-2105.58	230.	203.
SLED VELOCITY (FPS)	0.01	93.71	0.05	149.	0.
SHOULDER POINT FORCES (LB)					
LEFT X AXIS	0.60	9.71	-621.95	226.	76.
LEFT Y AXIS	5.67	9.26	-26.43	184.	60.
LEFT Z AXIS	6.03	56.36	3.60	72.	195.
LEFT RESULTANT	8.50	624.88	4.19	76.	339.
RIGHT X AXIS	-5.11	4.21	-552.01	191.	56.
RIGHT Y AXIS	1.90	27.88	-3.67	78.	319.
RIGHT Z AXIS	1.91	42.65	-3.02	34.	326.
RIGHT RESULTANT	5.90	553.93	0.56	56.	168.
SHOULDER ROLLER					
Y AXIS FORCE (LB)	-1.61	63.83	-10.76	47.	339.
Z AXIS FORCE (LB)	2.44	804.17	-11.37	75.	349.
X AXIS TORQUE (IN-LB)	3.22	123.45	-92.41	38.	61.



CHIA STUDY -GX TEST: 3520 SUBJ: ADAM-S WT: 143.0 NOM G: 30.0 CELL: I

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
HARNES ANCHOR FORCES (LB)					
LEFT HORIZ X AXIS	-6.74	19.34	-1374.57	211.	78.
LEFT HORIZ Y AXIS	-2.83	216.56	-10.62	90.	233.
LEFT HORIZ Z AXIS	1.67	128.57	-9.06	57.	349.
LEFT RESULTANT	7.72	1387.37	1.88	78.	264.
RIGHT HORIZ X AXIS	-0.85	31.27	-1406.60	226.	72.
RIGHT HORIZ Y AXIS	-0.14	7.07	-243.89	230.	81.
RIGHT HORIZ Z AXIS	-0.06	108.22	-10.08	102.	352.
RIGHT RESULTANT	1.37	1407.8	0.14	72.	0.
LEFT VERT X AXIS	-0.89	2.48	-211.63	217.	60.
LEFT VERT Y AXIS	-0.46	103.84	-8.03	74.	260.
LEFT VERT Z AXIS	-2.71	21.48	-248.02	32.	72.
LEFT RESULTANT	3.23	339.18	2.64	74.	3.
RIGHT VERT X AXIS	-3.40	4.14	-191.72	211.	62.
RIGHT VERT Y AXIS	-1.01	8.21	-43.52	35.	70.
RIGHT VERT Z AXIS	-11.08	14.15	-198.12	22.	64.
RIGHT RESULTANT	11.70	275.63	3.89	64.	380.
ADAM INTERNAL TEMP (DEG C)	62.08	62.83	61.83	13.	2.
ADAM ACCELERATIONS (G)					
HEAD X AXIS	0.75	10.05	-68.88	249.	75.
HEAD Z AXIS	0.73	6.75	-45.80	39.	61.
CHEST X AXIS	-1.07	13.14	-43.17	204.	47.
LUMBAR X AXIS	1.05	9.26	-60.08	203.	50.
ADAM FORCES (LB)					
NECK X AXIS	-5.10	640.30	-82.92	75.	212.
NECK Z AXIS	5.13	438.52	-58.24	82.	31.
LUMBAR X AXIS	54.91	205.95	-868.85	41.	76.
ADAM NECK MY TORQUE (IN-LB)	-60.99	272.87	-351.88	70.	51.

CHIA STUDY -GX TEST: 3521 SUBJ: ADAM-L WT: 216.0 NOM G: 40.0 CELL: J

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK TIME (MS)				-263.	
2.5V EXT POWER (VOLTS)	2.50	2.51	2.49	177.	178.
10V EXT POWER (VOLTS)	10.00	10.00	10.00	177.	178.
SLED ACCELERATION (G)					
X AXIS	0.00	1.00	-40.28	130.	64.
Y AXIS	0.00	1.59	-2.30	48.	104.
Z AXIS	0.98	4.75	-2.98	26.	32.
SEAT ACCELERATION (G)					
X AXIS	0.44	2.77	-38.13	132.	66.
Y AXIS	-0.04	5.30	-4.76	68.	45.
Z AXIS	0.85	25.03	-0.37	60.	132.
RESULTANT	0.96	45.10	0.97	60.	161.
CHEST ACCELERATION (G)					
X AXIS	1.02	7.67	-71.98	190.	48.
Y AXIS	0.18	64.72	-49.56	55.	60.
Z AXIS	0.70	55.56	-5.88	55.	190.
RESULTANT	1.25	87.23	0.64	55.	162.
RY (RAD/SEC2)	12.84	10895.33	-12214.68	69.	60.
SLED VELOCITY (FPS)	0.02	107.47	-0.01	142.	2.
SHOULDER POINT FORCES (LB)					
LEFT X AXIS	-2.98	5.53	-1147.25	168.	64.
LEFT Y AXIS	0.00	4.60	-86.34	127.	53.
LEFT Z AXIS	0.83	76.57	-2.57	63.	149.
LEFT RESULTANT	3.13	1151.21	1.60	64.	186.
RIGHT X AXIS	-6.29	5.32	-1373.30	177.	72.
RIGHT Y AXIS	0.81	128.44	-7.10	71.	161.
RIGHT Z AXIS	-0.19	46.99	-6.29	27.	131.
RIGHT RESULTANT	6.39	1379.47	1.73	72.	170.
SHOULDER ROLLER					
Y AXIS FORCE (LB)	1.54	115.41	-28.45	82.	111.
Z AXIS FORCE (LB)	7.41	1515.04	-18.78	58.	181.
X AXIS TORQUE (IN-LB)	2.73	830.57	-27.43	75.	181.

CHIA STUDY -GX TEST: 3521 SUBJ: ADAM-L WT: 216.0 NOM G: 40.0 CELL: J

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
HARNESS ANCHOR FORCES (LB)					
LEFT HORIZ X AXIS	-0.49	37.67	-4363.83	188.	65.
LEFT HORIZ Y AXIS	-23.77	173.57	-340.21	91.	64.
LEFT HORIZ Z AXIS	1.77	127.56	-17.31	60.	182.
LEFT RESULTANT	23.96	4378.34	4.58	65.	179.
RIGHT HORIZ X AXIS	1.89	46.09	-3388.47	178.	68.
RIGHT HORIZ Y AXIS	17.81	92.04	-162.45	68.	32.
RIGHT HORIZ Z AXIS	-11.86	117.68	-37.88	50.	75.
RIGHT RESULTANT	21.56	3389.74	4.20	68.	173.
LEFT VERT X AXIS	-4.32	-4.14	-476.15	0.	66.
LEFT VERT Y AXIS	-2.42	273.45	-6.23	65.	31.
LEFT VERT Z AXIS	-24.90	28.34	-710.75	23.	66.
LEFT RESULTANT	25.40	896.60	20.14	66.	6.
RIGHT VERT X AXIS	0.00	6.89	-551.67	177.	67.
RIGHT VERT Y AXIS	-1.03	13.83	-179.30	39.	71.
RIGHT VERT Z AXIS	-7.15	34.41	-805.02	26.	71.
RIGHT RESULTANT	7.35	988.22	4.52	71.	2.
ADAM INTERNAL TEMP (DEG C)	-258.91	-253.36	-260.11	177.	181.
ADAM ACCELERATIONS (G)					
HEAD X AXIS	0.49	4.59	-98.80	177.	73.
HEAD Z AXIS	1.05	28.24	-99.94	44.	59.
CHEST X AXIS	0.81	17.23	-60.44	190.	58.
LUMBAR X AXIS	0.66	6.46	-93.20	190.	43.
ADAM FORCES (LB)					
NECK X AXIS	-20.71	976.68	-53.01	73.	190.
NECK Z AXIS	11.06	1143.19	-1665.86	60.	85.
LUMBAR X AXIS	0.48	250.38	-3175.66	42.	73.
ADAM NECK MY TORQUE (IN-LB)	-1.39	1439.89	-395.31	67.	54.

CHIA STUDY -GX TEST: 3523 SUBJ: ADAM-S WT: 143.0 NOM G: 40.0 CELL: J

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK TIME (MS)				-279.	
2.5V EXT POWER (VOLTS)	2.50	2.50	2.49	67.	55.
10V EXT POWER (VOLTS)	10.00	10.00	10.00	67.	55.
SLED ACCELERATION (G)					
X AXIS	-0.03	1.01	-88.47	169.	64.
Y AXIS	-0.02	1.52	-0.73	207.	110.
Z AXIS	1.01	4.73	-1.90	28.	34.
SEAT ACCELERATION (G)					
X AXIS	0.50	2.98	-37.74	132.	69.
Y AXIS	-0.05	5.48	-2.62	70.	58.
Z AXIS	0.82	24.64	-0.66	61.	132.
RESULTANT	0.96	44.48	0.46	69.	253.
CHEST ACCELERATION (G)					
X AXIS	0.62	25.02	-61.70	191.	66.
Y AXIS	0.15	18.19	-5.91	65.	55.
Z AXIS	0.06	59.95	-14.90	72.	194.
RESULTANT	1.07	70.23	0.55	72.	305.
RY (RAD/SEC2)	-1.55	7213.62	-6114.38	191.	182.
SLED VELOCITY (FPS)	0.00	106.84	-0.02	160.	0.
SHOULDER POINT FORCES (LB)					
LEFT X AXIS	-7.66	5.13	-824.87	211.	65.
LEFT Y AXIS	5.29	9.14	-31.15	127.	56.
LEFT Z AXIS	5.00	61.63	1.19	63.	213.
LEFT RESULTANT	10.75	922.98	4.76	65.	158.
RIGHT X AXIS	-5.01	6.93	-892.97	150.	60.
RIGHT Y AXIS	1.23	67.98	-4.46	68.	160.
RIGHT Z AXIS	1.55	50.70	-2.59	29.	132.
RIGHT RESULTANT	5.64	896.47	1.56	67.	154.
SHOULDER ROLLER					
Y AXIS FORCE (LB)	-1.92	54.92	-49.87	68.	43.
Z AXIS FORCE (LB)	7.05	1197.13	-11.22	64.	215.
X AXIS TORQUE (IN-LB)	-7.66	242.15	-99.41	68.	36.

CHIA STUDY -GX TEST: 3523 SUBJ: ADAM-S WT: 143.0 NOM G: 40.0 CELL: J

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
HARNESS ANCHOR FORCES (LB)					
LEFT HORIZ X AXIS	-3.85	69.32	-2379.45	216.	64.
LEFT HORIZ Y AXIS	-2.51	228.30	-110.72	97.	65.
LEFT HORIZ Z AXIS	1.73	64.83	-36.58	28.	47.
LEFT RESULTANT	5.79	2382.12	1.20	65.	266.
RIGHT HORIZ X AXIS	-5.90	50.61	-2322.81	208.	67.
RIGHT HORIZ Y AXIS	3.19	24.53	-233.50	192.	81.
RIGHT HORIZ Z AXIS	0.01	206.41	-3.25	74.	150.
RIGHT RESULTANT	6.77	2329.91	3.35	67.	163.
LEFT VERT X AXIS	-4.05	-1.90	-213.57	1.	59.
LEFT VERT Y AXIS	4.44	97.10	0.48	58.	32.
LEFT VERT Z AXIS	-32.42	12.50	-261.09	20.	58.
LEFT RESULTANT	32.99	350.32	18.32	59.	329.
RIGHT VERT X AXIS	-1.25	3.63	-221.25	182.	59.
RIGHT VERT Y AXIS	-0.33	6.83	-103.53	31.	63.
RIGHT VERT Z AXIS	-12.87	32.16	-254.08	28.	57.
RIGHT RESULTANT	13.06	349.56	10.31	61.	2.
ADAM INTERNAL TEMP (DEG C)	64.71	112.47	-297.12	68.	62.
ADAM ACCELERATIONS (G)					
HEAD X AXIS	0.71	71.31	-57.80	208.	68.
HEAD Z AXIS	0.82	6.39	-71.05	30.	56.
CHEST X AXIS	-1.00	15.92	-49.93	185.	53.
LUMBAR X AXIS	1.01	9.68	-67.46	182.	45.
ADAM FORCES (LB)					
NECK X AXIS	-6.41	1012.34	-76.55	69.	194.
NECK Z AXIS	17.90	1241.32	-38.45	62.	29.
LUMBAR X AXIS	44.39	638.47	-670.53	87.	57.
ADAM NECK MY TORQUE (IN-LB)	-38.31	668.52	-344.27	62.	46.

CHIA STUDY -GX TEST: 3524 SUBJ: ADAM-S WT: 143.0 NOM G: 40.0 CELL: J

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK TIME (MS)				-296.	
2.5V EXT POWER (VOLTS)	2.50	2.51	2.49	63.	252.
10V EXT POWER (VOLTS)	10.00	10.00	10.00	176.	28.
SLED ACCELERATION (G)					
X AXIS	-0.04	2.74	-41.03	163.	65.
Y AXIS	0.00	2.35	-1.45	232.	268.
Z AXIS	0.96	2.60	-1.64	41.	46.
SEAT ACCELERATION (G)					
X AXIS	0.39	4.73	-37.85	133.	74.
Y AXIS	-0.06	4.69	-2.23	41.	202.
Z AXIS	0.81	24.42	-2.36	62.	133.
RESULTANT	0.90	44.23	0.92	60.	0.
CHEST ACCELERATION (G)					
X AXIS	0.64	18.78	-58.54	180.	45.
Y AXIS	0.13	12.28	-19.58	38.	46.
Z AXIS	0.75	40.36	-11.95	47.	186.
RESULTANT	1.00	70.64	0.58	46.	149.
RY (RAD/SEC2)	-16.76	5815.41	-4134.73	194.	180.
SLED VELOCITY (FPS)	0.02	107.26	-0.03	132.	0.
SHOULDER POINT FORCES (LB)					
LEFT X AXIS	-4.65	15.24	-853.29	154.	70.
LEFT Y AXIS	5.71	16.03	-32.32	165.	56.
LEFT Z AXIS	8.03	84.87	1.15	64.	133.
LEFT RESULTANT	10.92	857.27	3.70	70.	207.
RIGHT X AXIS	-3.51	8.10	-798.41	153.	74.
RIGHT Y AXIS	0.67	55.46	-8.81	74.	203.
RIGHT Z AXIS	0.85	45.60	-8.96	66.	133.
RIGHT RESULTANT	3.81	801.30	0.65	74.	176.
SHOULDER ROLLER					
Y AXIS FORCE (LB)	-6.68	64.30	-33.39	210.	85.
Z AXIS FORCE (LB)	1.94	1127.99	-46.69	71.	215.
X AXIS TORQUE (IN-LB)	-8.64	233.19	-81.05	210.	64.

CHIA STUDY -GX TEST: 3524 SUBJ: ADAM-S WT: 143.0 NOM G: 40.0 CELL: J

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
HARNES ANCHOR FORCES (LB)					
LEFT HORIZ X AXIS	-11.93	101.09	-1883.04	182.	50.
LEFT HORIZ Y AXIS	-2.51	212.71	-52.92	87.	184.
LEFT HORIZ Z AXIS	-1.53	126.76	-21.73	86.	132.
LEFT RESULTANT	12.56	1884.45	3.71	51.	239.
RIGHT HORIZ X AXIS	-16.90	113.27	-2165.97	185.	50.
RIGHT HORIZ Y AXIS	-1.01	35.56	-204.80	191.	56.
RIGHT HORIZ Z AXIS	-0.08	232.99	-13.86	51.	167.
RIGHT RESULTANT	17.03	2183.99	0.47	50.	249.
LEFT VERT X AXIS	-1.99	27.30	-181.94	186.	60.
LEFT VERT Y AXIS	-2.35	47.09	-3.76	59.	12.
LEFT VERT Z AXIS	-7.36	20.91	-273.09	20.	184.
LEFT RESULTANT	8.03	276.15	6.15	186.	3.
RIGHT VERT X AXIS	-3.71	21.54	-152.55	184.	53.
RIGHT VERT Y AXIS	-0.34	5.04	-36.35	30.	66.
RIGHT VERT Z AXIS	-0.25	25.73	-260.52	25.	186.
RIGHT RESULTANT	3.88	262.53	3.85	186.	0.
ADAM INTERNAL TEMP (DEG C)	60.39	61.73	60.23	256.	6.
ADAM ACCELERATIONS (G)					
HEAD X AXIS	0.82	102.72	-81.34	209.	71.
HEAD Z AXIS	0.86	6.05	-64.08	32.	58.
CHEST X AXIS	-0.68	18.93	-51.06	178.	76.
LUMBAR X AXIS	1.01	22.91	-72.21	174.	46.
ADAM FORCES (LB)					
NECK X AXIS	-7.60	782.31	-69.30	71.	189.
NECK Z AXIS	-7.10	601.97	-49.14	76.	32.
LUMBAR X AXIS	-1.22	325.27	-436.33	40.	73.
ADAM NECK MY TORQUE (IN-LB)	-11.55	376.79	-313.93	67.	47.

CHIA STUDY -GX TEST: 3525 SUBJ: ADAM-L WT: 216.0 NOM G: 40.0 CELL: J

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK TIME (MS)				-210.	
2.5V EXT POWER (VOLTS)	2.50	2.52	2.49	195.	96.
10V EXT POWER (VOLTS)	10.00	10.00	10.00	170.	69.
SLED ACCELERATION (G)					
X AXIS	-0.02	0.96	-40.91	129.	63.
Y AXIS	-0.02	1.76	-2.16	47.	180.
Z AXIS	1.00	4.82	-3.05	27.	33.
SEAT ACCELERATION (G)					
X AXIS	0.46	4.34	-38.69	208.	48.
Y AXIS	-0.04	10.21	-3.69	63.	43.
Z AXIS	0.84	26.29	-1.15	60.	163.
RESULTANT	0.96	45.33	0.39	49.	366.
CHEST ACCELERATION (G)					
X AXIS	0.71	26.84	-86.19	202.	74.
Y AXIS	0.29	27.46	-34.71	57.	52.
Z AXIS	0.72	70.90	-17.44	53.	224.
RESULTANT	1.06	98.35	0.47	52.	170.
RY (RAD/SEC2)	-3.15	14017.94	-14777.88	78.	199.
SLED VELOCITY (FPS)	0.00	107.63	-0.04	143.	0.
SHOULDER POINT FORCES (LB)					
LEFT X AXIS	-2.24	18.87	-1252.34	207.	72.
LEFT Y AXIS	-0.29	13.79	-99.03	159.	73.
LEFT Z AXIS	-0.13	74.51	-5.78	70.	164.
LEFT RESULTANT	2.35	1258.21	0.87	72.	231.
RIGHT X AXIS	-4.16	19.07	-1335.72	207.	72.
RIGHT Y AXIS	0.29	126.17	-15.21	69.	186.
RIGHT Z AXIS	-0.36	48.34	-7.49	28.	132.
RIGHT RESULTANT	4.40	1339.55	0.81	72.	1.
SHOULDER ROLLER					
Y AXIS FORCE (LB)	-0.01	76.09	-26.93	68.	72.
Z AXIS FORCE (LB)	3.53	1620.09	-25.96	68.	204.
X AXIS TORQUE (IN-LB)	0.04	341.18	-11.31	47.	134.



CHIA STUDY -GX TEST: 3525 SUBJ: ADAM-L WT: 216.0 NOM G: 40.0 CELL: J

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
HARNES ANCHOR FORCES (LB)					
LEFT HORIZ X AXIS	-5.93	122.06	-3965.50	210.	71.
LEFT HORIZ Y AXIS	-25.82	158.75	-260.67	88.	72.
LEFT HORIZ Z AXIS	-3.56	285.90	-11.08	68.	164.
LEFT RESULTANT	26.93	3977.96	3.14	71.	376.
RIGHT HORIZ X AXIS	-6.42	49.85	-3453.77	202.	71.
RIGHT HORIZ Y AXIS	18.30	209.04	-165.63	68.	85.
RIGHT HORIZ Z AXIS	-8.82	337.14	-14.54	48.	336.
RIGHT RESULTANT	21.40	3459.64	1.19	71.	302.
LEFT VERT X AXIS	-1.25	10.07	-284.32	171.	71.
LEFT VERT Y AXIS	-1.60	101.47	-14.21	74.	225.
LEFT VERT Z AXIS	-2.68	32.50	-281.91	25.	72.
LEFT RESULTANT	3.86	411.24	2.58	72.	0.
RIGHT VERT X AXIS	-1.27	16.03	-386.57	206.	71.
RIGHT VERT Y AXIS	-0.72	19.24	-104.91	50.	72.
RIGHT VERT Z AXIS	-0.98	32.42	-466.09	26.	72.
RIGHT RESULTANT	2.85	612.28	2.57	72.	0.
ADAM INTERNAL TEMP (DEG C)	-258.60	-255.35	-259.10	68.	71.
ADAM ACCELERATIONS (G)					
HEAD X AXIS	-0.04	27.96	-101.02	221.	74.
HEAD Z AXIS	0.91	28.73	-103.87	45.	76.
CHEST X AXIS	0.28	38.77	-65.53	198.	56.
LUMBAR X AXIS	0.33	18.53	-98.53	199.	44.
ADAM FORCES (LB)					
NECK X AXIS	-11.58	959.62	-146.58	75.	205.
NECK Z AXIS	14.58	1153.73	-188.36	74.	45.
LUMBAR X AXIS	15.66	427.41	-2394.04	201.	75.
ADAM NECK MY TORQUE (IN-LB)	-3.37	1441.22	-347.13	70.	61.

CHIA STUDY -GX TEST: 3526 SUBJ: ADAM-S WT: 143.0 NOM G: 45.0 CELL: K

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK TIME (MS)				-202.	
2.5V EXT POWER (VOLTS)	2.50	2.51	2.50	74.	196.
10V EXT POWER (VOLTS)	10.00	10.00	10.00	198.	39.
SLED ACCELERATION (G)					
X AXIS	0.00	1.10	-44.66	266.	62.
Y AXIS	-0.01	3.14	-1.61	186.	180.
Z AXIS	0.99	4.83	-2.79	25.	31.
SEAT ACCELERATION (G)					
X AXIS	0.45	2.85	-45.85	126.	48.
Y AXIS	-0.03	7.17	-4.17	66.	48.
Z AXIS	0.84	25.18	-0.30	48.	128.
RESULTANT	0.95	52.48	0.59	48.	351.
CHEST ACCELERATION (G)					
X AXIS	0.69	19.13	-91.11	189.	61.
Y AXIS	0.19	19.71	-7.00	69.	201.
Z AXIS	0.85	83.40	-12.08	68.	192.
RESULTANT	1.12	93.94	0.64	69.	279.
RY (RAD/SEC2)	-1.20	7549.89	-9476.94	42.	181.
SLED VELOCITY (FPS)	0.02	111.78	0.03	156.	0.
SHOULDER POINT FORCES (LB)					
LEFT X AXIS	-0.69	11.60	-896.40	148.	67.
LEFT Y AXIS	1.64	14.97	-48.35	200.	52.
LEFT Z AXIS	1.24	79.23	-2.20	61.	127.
LEFT RESULTANT	2.43	899.77	0.26	67.	182.
RIGHT X AXIS	-3.28	8.18	-865.87	162.	68.
RIGHT Y AXIS	0.26	53.96	-16.15	64.	189.
RIGHT Z AXIS	0.24	50.70	-3.86	27.	265.
RIGHT RESULTANT	3.40	868.48	0.32	68.	148.
SHOULDER ROLLER					
Y AXIS FORCE (LB)	-0.47	55.27	-28.20	96.	190.
Z AXIS FORCE (LB)	3.29	1170.34	-4.34	63.	154.
X AXIS TORQUE (IN-LB)	2.62	182.86	-87.66	93.	214.

CHIA STUDY -GX TEST: 3526 SUBJ: ADAM-S WT: 143.0 NOM G: 45.0 CELL: K

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
HARNES ANCHOR FORCES (LB)					
LEFT HORIZ X AXIS	0.01	31.64	-2335.50	195.	63.
LEFT HORIZ Y AXIS	-2.04	212.64	-25.03	85.	195.
LEFT HORIZ Z AXIS	-0.60	94.82	-10.21	51.	163.
LEFT RESULTANT	2.98	2337.44	0.89	63.	0.
RIGHT HORIZ X AXIS	-1.62	30.26	-2205.02	190.	63.
RIGHT HORIZ Y AXIS	-0.50	17.18	-237.32	202.	44.
RIGHT HORIZ Z AXIS	-1.34	122.34	-12.92	90.	160.
RIGHT RESULTANT	3.81	2209.37	1.38	63.	0.
LEFT VERT X AXIS	-1.24	1.85	-324.18	360.	60.
LEFT VERT Y AXIS	-1.54	180.64	-12.59	62.	368.
LEFT VERT Z AXIS	-11.61	24.83	-412.09	24.	60.
LEFT RESULTANT	11.83	553.74	4.05	61.	399.
RIGHT VERT X AXIS	0.13	10.74	-337.46	190.	59.
RIGHT VERT Y AXIS	-2.08	7.14	-144.61	371.	61.
RIGHT VERT Z AXIS	-3.53	28.75	-437.60	22.	60.
RIGHT RESULTANT	4.48	570.35	0.34	60.	348.
ADAM INTERNAL TEMP (DEG C)	66.95	68.89	66.39	33.	239.
ADAM ACCELERATIONS (G)					
HEAD X AXIS	0.68	64.09	-119.77	213.	65.
HEAD Z AXIS	0.66	19.49	-95.29	40.	54.
CHEST X AXIS	-0.92	12.63	-68.66	180.	41.
LUMBAR X AXIS	0.83	18.20	-86.99	55.	40.
ADAM FORCES (LB)					
NECK X AXIS	-3.56	1137.78	-61.63	65.	190.
NECK Z AXIS	-2.53	950.28	-128.82	68.	40.
LUMBAR X AXIS	8.85	333.20	-2181.67	39.	67.
ADAM NECK MY TORQUE (IN-LB)					
	-4.66	717.10	-458.67	62.	45.

CHIA STUDY -GX TEST: 3527 SUBJ: ADAM-L WT: 216.0 NOM G: 45.0 CELL: K

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK TIME (MS)				-179.	
2.5V EXT POWER (VOLTS)	2.50	2.52	2.49	85.	11.
10V EXT POWER (VOLTS)	10.00	10.00	10.00	270.	8.
SLED ACCELERATION (G)					
X AXIS	0.00	2.44	-43.87	167.	62.
Y AXIS	-0.02	2.74	-2.31	188.	177.
Z AXIS	0.97	5.10	-3.54	33.	38.
SEAT ACCELERATION (G)					
X AXIS	0.54	4.63	-41.85	159.	57.
Y AXIS	-0.05	7.85	-4.98	203.	180.
Z AXIS	0.81	24.76	-2.50	33.	186.
RESULTANT	0.97	47.72	0.62	57.	360.
CHEST ACCELERATION (G)					
X AXIS	0.83	67.13	-75.25	180.	67.
Y AXIS	0.32	26.65	-48.41	41.	49.
Z AXIS	0.83	49.68	-46.13	49.	181.
RESULTANT	1.23	84.64	0.44	54.	318.
RY (RAD/SEC2)	-9.33	14017.64	-11874.14	42.	47.
SLED VELOCITY (FPS)	0.03	111.57	0.00	132.	0.
SHOULDER POINT FORCES (LB)					
LEFT X AXIS	-2.05	7.82	-1342.36	191.	67.
LEFT Y AXIS	4.13	22.06	-109.18	212.	51.
LEFT Z AXIS	3.77	81.41	-4.61	66.	137.
LEFT RESULTANT	6.37	1348.38	0.97	68.	189.
RIGHT X AXIS	-6.34	21.93	-1225.58	185.	68.
RIGHT Y AXIS	1.54	105.98	-15.54	63.	236.
RIGHT Z AXIS	1.19	53.26	-10.18	33.	186.
RIGHT RESULTANT	6.69	1229.08	2.08	68.	387.
SHOULDER ROLLER					
Y AXIS FORCE (LB)	1.74	23.12	-40.82	63.	105.
Z AXIS FORCE (LB)	4.79	1699.47	-28.88	65.	185.
X AXIS TORQUE (IN-LB)	8.72	46.24	-248.87	222.	55.

CHIA STUDY -GX TEST: 3527 SUBJ: ADAM-L WT: 216.0 NOM G: 45.0 CELL: K

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
HARNES ANCHOR FORCES (LB)					
LEFT HORIZ X AXIS	0.37	56.88	-3716.73	234.	66.
LEFT HORIZ Y AXIS	-19.08	140.08	-251.37	82.	66.
LEFT HORIZ Z AXIS	-0.48	105.25	-202.60	49.	70.
LEFT RESULTANT	19.14	3727.76	10.20	66.	369.
RIGHT HORIZ X AXIS	0.23	144.16	-4313.85	231.	64.
RIGHT HORIZ Y AXIS	18.28	250.75	-173.41	64.	83.
RIGHT HORIZ Z AXIS	-13.40	98.07	-57.49	47.	75.
RIGHT RESULTANT	22.75	4321.17	4.75	64.	174.
LEFT VERT X AXIS	-1.59	9.64	-754.34	217.	60.
LEFT VERT Y AXIS	-2.46	269.63	-20.21	56.	230.
LEFT VERT Z AXIS	-14.23	28.17	-951.83	21.	66.
LEFT RESULTANT	14.59	1218.22	3.39	67.	430.
RIGHT VERT X AXIS	-1.41	21.47	-602.37	189.	64.
RIGHT VERT Y AXIS	1.59	17.18	-184.58	156.	63.
RIGHT VERT Z AXIS	-9.86	25.02	-878.73	20.	64.
RIGHT RESULTANT	10.31	1080.95	7.33	64.	3.
ADAM INTERNAL TEMP (DEG C)	77.52	78.62	76.62	69.	236.
ADAM ACCELERATIONS (G)					
HEAD X AXIS	0.12	130.09	-116.79	188.	70.
HEAD Z AXIS	0.87	32.78	-107.69	42.	72.
CHEST X AXIS	0.49	38.67	-70.75	179.	52.
LUMBAR X AXIS	0.29	13.24	-98.11	49.	41.
ADAM FORCES (LB)					
NECK X AXIS	-8.06	1160.53	-144.51	70.	185.
NECK Z AXIS	10.27	796.09	-225.47	72.	42.
LUMBAR X AXIS	16.26	418.70	-3926.33	184.	71.
ADAM NECK MY TORQUE (IN-LB)	-1.84	1607.20	-418.39	65.	55.

## APPENDIX C

### Data Summaries for Human Tests

Note: Cell D is the X-Band 90 degree Harness

Cell B is the X-Band 45 degree Harness

CREST STUDY -GX TEST: 3088 SUBJ: P-5 WT: 182.0 NOM G: 10.0 CELL: 8

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK				-113.	
2.5V EXT PWR		2.50	2.50	43.	0.
10V EXT PWR		10.01	9.99	4.	175.
SLED ACCELERATION (G)					
X AXIS	-0.02	0.49	-9.81	157.	55.
Y AXIS	0.00	0.32	-0.99	174.	299.
Z AXIS	1.00	2.47	-0.68	55.	50.
SEAT ACCELERATION (G)					
X AXIS	0.11	2.15	-10.56	158.	49.
Y AXIS	0.00	1.51	-1.53	179.	170.
Z AXIS	0.87	8.20	-0.01	55.	163.
SLED VELOCITY (FT/S)	0.00	30.45	0.00	153.	0.
CHEST ACCELERATION (G)					
X AXIS EXTERNAL	0.13	2.35	-13.83	171.	87.
Y AXIS EXTERNAL	0.01	4.75	-2.84	75.	213.
Z AXIS EXTERNAL	0.88	15.23	-2.76	77.	226.
RESULTANT	0.89	18.23	0.93	83.	163.
NORM RESULTANT	0.09	1.84	0.03	83.	163.
HEAD ACCELERATION (G)					
X AXIS EXTERNAL	0.13	2.02	-11.39	245.	86.
Y AXIS EXTERNAL	0.01	0.52	-0.81	162.	71.
Z AXIS EXTERNAL	0.85	3.45	-16.89	136.	86.
RESULTANT	0.86	20.21	0.55	86.	18.
NORM RESULTANT	0.09	2.04	0.08	86.	18.
RY EXTERNAL	-0.66	521.09	-425.75	136.	83.
LUMBAR ACCELERATION (G)					
X AXIS EXTERNAL	0.12	3.71	-11.89	175.	74.
Y AXIS EXTERNAL	0.00	1.67	-2.54	174.	97.
Z AXIS EXTERNAL	0.87	16.35	-5.95	66.	176.
RESULTANT	0.88	19.15	0.17	66.	238.
NORM RESULTANT	0.08	1.93	0.02	66.	238.
SHOULDER LOADS (LB)					
TENSION	98.87	1009.25	44.77	92.	209.
LEFT TENSION QRA	31.96	173.72	12.96	77.	186.
RIGHT TENSION QRA	29.10	182.18	27.05	75.	4.
LEG LOADS (LB)					
LEFT TENSION QRA	17.54	180.08	18.43	77.	6.
RIGHT TENSION QRA	21.84	184.14	17.15	81.	377.
ANCHOR LOADS (LB)					
LEFT 45 DEG X AXIS	25.93	398.92	12.12	82.	445.
LEFT 45 DEG Y AXIS	3.00	48.94	0.23	79.	187.
LEFT 45 DEG Z AXIS	13.79	238.80	4.69	81.	434.
LEFT 45 DEG RESULTANT	29.55	465.20	13.24	82.	453.
RIGHT 45 DEG X AXIS	22.95	382.57	3.85	80.	285.
RIGHT 45 DEG Y AXIS	3.00	49.78	-2.88	78.	285.
RIGHT 45 DEG Z AXIS	22.27	258.45	3.82	78.	284.
RIGHT 45 DEG RESULTANT	32.15	484.09	5.44	81.	294.
AT VERTICAL X AXIS	13.91	145.51	12.54	95.	2.
AT VERTICAL Y AXIS	-0.50	5.74	-5.01	159.	58.
AT VERTICAL Z AXIS	74.42	330.53	47.25	97.	33.
AT VERTICAL RESULTANT	75.72	361.18	50.22	97.	33.
SEAT LOADS (LB)					
LEFT LINK X AXIS	1.38	85.01	-189.19	183.	81.
RIGHT LINK X AXIS	48.71	74.39	-104.06	176.	82.
X AXIS SUM	48.10	138.19	-293.25	176.	82.
X AXIS MINUS TARE	48.81	139.68	-132.44	178.	86.
CENTER LINK Y AXIS	39.55	38.74	-114.48	0.	88.
LEFT Z AXIS	48.13	828.90	13.48	80.	430.
RIGHT Z AXIS	31.74	615.51	-5.38	78.	211.
CENTER Z AXIS	222.07	1072.84	222.31	88.	0.
Z AXIS SUM	299.95	2287.86	253.66	81.	221.
Z AXIS MINUS TARE	299.77	2201.21	277.01	82.	215.
RESULTANT	308.34	2309.09	222.17	81.	221.
RESULTANT MINUS TARE	308.25	2207.73	267.31	82.	215.

CREST STUDY -GX TEST: 3089 SUBJ: M21 WT: 129.0 NOM G: 10.0 CELL: 8

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK				-106.	
2.5V EXT PWR		2.50	2.50	18.	2.
10V EXT PWR		10.01	9.99	2.	44.
SLED ACCELERATION (G)					
X AXIS	-0.02	0.45	-10.09	174.	56.
Y AXIS	0.00	0.25	-0.22	287.	121.
Z AXIS	1.00	2.38	-0.75	56.	51.
SEAT ACCELERATION (G)					
X AXIS	0.11	1.91	-10.66	155.	50.
Y AXIS	0.00	1.19	-1.38	178.	168.
Z AXIS	0.87	8.21	-0.22	56.	169.
SLED VELOCITY (FT/S)	0.00	30.88	0.00	155.	0.
CHEST ACCELERATION (G)					
X AXIS EXTERNAL	0.13	2.79	-11.97	183.	97.
Y AXIS EXTERNAL	-0.01	6.05	-3.16	104.	118.
Z AXIS EXTERNAL	0.88	13.78	-2.39	117.	108.
RESULTANT	0.90	18.52	0.13	89.	213.
NORM RESULTANT	0.08	1.64	0.01	89.	213.
HEAD ACCELERATION (G)					
X AXIS EXTERNAL	0.13	1.48	-11.80	212.	78.
Y AXIS EXTERNAL	0.01	0.46	-1.68	310.	76.
Z AXIS EXTERNAL	0.88	3.30	-18.21	143.	77.
RESULTANT	0.87	21.77	0.80	77.	20.
NORM RESULTANT	0.09	2.16	0.08	77.	20.
RY EXTERNAL	-0.68	1079.46	-810.70	118.	74.
LUMBAR ACCELERATION (G)					
X AXIS EXTERNAL	0.11	2.53	-13.01	182.	80.
Y AXIS EXTERNAL	0.00	1.88	-2.48	63.	79.
Z AXIS EXTERNAL	0.87	18.10	-2.68	67.	31.
RESULTANT	0.88	20.01	0.55	67.	400.
NORM RESULTANT	0.09	1.98	0.05	67.	400.
SHOULDER LOADS (LB)					
TENSION	87.47	720.88	88.31	83.	0.
LEFT TENSION QRA	35.09	125.11	18.72	76.	250.
RIGHT TENSION QRA	40.97	153.96	27.92	76.	183.
LEG LOADS (LB)					
LEFT TENSION QRA	20.10	138.37	13.42	76.	176.
RIGHT TENSION QRA	28.67	118.19	22.62	77.	165.
ANCHOR LOADS (LB)					
LEFT 45 DEG X AXIS	30.04	340.94	21.23	78.	185.
LEFT 45 DEG Y AXIS	10.11	74.53	4.94	80.	176.
LEFT 45 DEG Z AXIS	15.28	206.55	2.02	79.	186.
LEFT 45 DEG RESULTANT	35.22	404.37	23.06	80.	187.
RIGHT 45 DEG X AXIS	28.30	330.83	23.39	83.	275.
RIGHT 45 DEG Y AXIS	7.52	78.71	4.21	84.	172.
RIGHT 45 DEG Z AXIS	31.18	266.87	24.57	84.	269.
RIGHT 45 DEG RESULTANT	41.49	450.55	34.37	84.	282.
RY VERTICAL X AXIS	-5.87	14.45	-7.71	49.	0.
RY VERTICAL Y AXIS	10.85	12.80	5.27	53.	185.
RY VERTICAL Z AXIS	57.09	152.58	28.84	95.	37.
RY VERTICAL RESULTANT	58.40	153.28	30.88	95.	42.
SEAT LOADS (LB)					
LEFT LINK X AXIS	21.05	21.47	-172.48	0.	81.
RIGHT LINK X AXIS	1.83	1.49	-126.80	1.	84.
X AXIS SUM	22.88	21.79	-298.13	0.	82.
X AXIS MINUS TARE	23.07	58.70	-193.45	26.	79.
CENTER LINK Y AXIS	-43.42	-2.50	-192.62	223.	79.
LEFT Z AXIS	44.85	418.70	8.89	78.	188.
RIGHT Z AXIS	31.87	335.12	7.94	81.	317.
CENTER Z AXIS	149.20	854.38	149.20	81.	0.
Z AXIS SUM	225.72	1849.98	227.50	81.	0.
Z AXIS MINUS TARE	225.61	1548.44	228.28	81.	0.
RESULTANT	230.87	1887.11	232.58	81.	0.
RESULTANT MINUS TARE	230.80	1565.48	231.65	81.	0.



CREST STUDY -GX TEST: 3117 SUBJ: B-1 MT: 170.0 NOM G: 10.0 CELL: B

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK					
2.5V EXT PWR		2.50	2.50	-155.	
10V EXT PWR		10.01	9.99	181.	3.
				7.	26.
SLED ACCELERATION (G)					
X AXIS	-0.01	0.52	-10.00	158.	56.
Y AXIS	0.00	0.30	-0.22	317.	58.
Z AXIS	1.00	2.57	-0.65	55.	51.
SEAT ACCELERATION (G)					
X AXIS	0.12	2.47	-10.54	160.	49.
Y AXIS	0.00	1.32	-1.84	182.	174.
Z AXIS	0.87	8.10	-1.06	55.	167.
SLED VELOCITY (FT/S)	0.00	30.57	0.00	156.	0.
CHEST ACCELERATION (G)					
X AXIS EXTERNAL	0.09	2.77	-15.88	174.	73.
Y AXIS EXTERNAL	0.00	7.94	-3.13	36.	174.
Z AXIS EXTERNAL	0.88	12.86	-9.36	91.	169.
RESULTANT	0.89	16.11	0.31	73.	205.
NORM RESULTANT	0.09	1.81	0.03	73.	205.
HEAD ACCELERATION (G)					
X AXIS EXTERNAL	0.25	1.81	-8.41	245.	95.
Y AXIS EXTERNAL	-0.01	0.70	-1.33	159.	199.
Z AXIS EXTERNAL	0.99	4.49	-9.77	178.	76.
RESULTANT	1.02	12.48	0.12	90.	17.
NORM RESULTANT	0.10	1.25	0.01	90.	17.
HY EXTERNAL	4.48	400.62	-266.00	117.	220.
THORAX ACCELERATION (G)					
X AXIS EXTERNAL	-0.01	9.57	-11.98	184.	82.
Y AXIS EXTERNAL	-0.02	1.56	-1.28	210.	85.
Z AXIS EXTERNAL	0.00	11.17	-1.11	52.	166.
RESULTANT	0.05	13.44	0.04	85.	383.
NORM RESULTANT	0.00	1.34	0.00	85.	383.
LUMBAR ACCELERATION (G)					
X AXIS EXTERNAL	0.11	8.28	-13.10	182.	89.
Y AXIS EXTERNAL	0.01	5.37	-7.20	70.	177.
Z AXIS EXTERNAL	0.87	12.81	-14.42	70.	177.
RESULTANT	0.88	17.27	0.15	70.	225.
NORM RESULTANT	0.09	1.73	0.02	70.	225.
SHOULDER LOADS (LB)					
TENSION	179.82	733.29	69.40	86.	180.
LEFT TENSION QAA	80.20	225.88	32.01	84.	167.
RIGHT TENSION QAA	54.97	222.03	28.12	86.	179.
LEG LOADS (LB)					
ANCHOR LOADS (LB)					
LEFT 45 DEG X AXIS	40.46	438.37	12.08	84.	401.
LEFT 45 DEG Y AXIS	2.71	37.46	-0.81	85.	188.
LEFT 45 DEG Z AXIS	25.43	280.78	0.41	84.	424.
LEFT 45 DEG RESULTANT	47.88	520.25	12.38	85.	425.
RIGHT 45 DEG X AXIS	40.34	439.55	25.81	85.	423.
RIGHT 45 DEG Y AXIS	4.85	85.56	-1.23	90.	171.
RIGHT 45 DEG Z AXIS	45.34	357.78	22.47	86.	450.
RIGHT 45 DEG RESULTANT	61.01	568.85	34.32	85.	450.
AT VERTICAL X AXIS	-18.85	37.50	-20.12	105.	0.
AT VERTICAL Y AXIS	2.31	2.22	-8.31	0.	57.
AT VERTICAL Z AXIS	88.18	145.38	33.25	114.	46.
AT VERTICAL RESULTANT	90.20	150.17	33.52	115.	46.
SEAT LOADS (LB)					
LEFT LINK X AXIS	29.25	88.58	-130.40	181.	79.
RIGHT LINK X AXIS	9.97	35.48	-158.99	448.	82.
X AXIS SUM	27.21	83.22	-287.39	180.	82.
X AXIS MINUS TARE	27.40	84.95	-139.57	421.	87.
CENTER LINK Y AXIS	-50.35	8.84	-189.39	343.	88.
LEFT Z AXIS	33.08	321.40	-5.67	82.	295.
RIGHT Z AXIS	49.32	529.77	34.31	80.	201.
CENTER Z AXIS	267.40	1008.44	254.78	89.	0.
Z AXIS SUM	338.80	2048.21	288.07	88.	203.
Z AXIS MINUS TARE	338.75	1954.17	298.47	88.	205.
RESULTANT	344.53	2074.08	292.89	88.	203.
RESULTANT MINUS TARE	344.55	1966.41	304.59	88.	205.

CREST STUDY -GX TEST: 0110 SUBJ: 0-5 WT: 175.0 NOM G: 10.0 CELL: B

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK				-153.	
2.5V EXT PWR		2.50	2.50	199.	0.
10V EXT PWR		10.01	9.39	2.	72.
SLED ACCELERATION (G)					
X AXIS	-0.02	0.52	-10.05	157.	56.
Y AXIS	0.00	0.38	-0.42	259.	122.
Z AXIS	1.00	2.44	-0.61	55.	50.
SEAT ACCELERATION (G)					
X AXIS	0.12	2.65	-10.60	158.	49.
Y AXIS	0.00	1.23	-1.23	224.	171.
Z AXIS	0.88	8.02	-0.70	55.	164.
SLED VELOCITY (FT/S)	0.00	30.51	0.00	154.	0.
CHEST ACCELERATION (G)					
X AXIS EXTERNAL	0.14	2.49	-21.85	179.	84.
Y AXIS EXTERNAL	-0.01	8.79	-2.94	95.	172.
Z AXIS EXTERNAL	0.87	14.32	-4.20	101.	169.
RESULTANT	0.88	22.26	0.20	84.	224.
NORM RESULTANT	0.09	2.21	0.02	84.	224.
HEAD ACCELERATION (G)					
X AXIS EXTERNAL	0.15	2.71	-13.55	212.	101.
Y AXIS EXTERNAL	-0.02	0.84	-0.73	229.	114.
Z AXIS EXTERNAL	0.84	4.17	-18.33	116.	87.
RESULTANT	0.85	19.65	0.34	90.	21.
NORM RESULTANT	0.08	1.96	0.03	90.	21.
AT EXTERNAL	-2.05	735.71	-302.58	118.	237.
THORAX ACCELERATION (G)					
X AXIS EXTERNAL	-0.01	1.58	-18.21	185.	83.
Y AXIS EXTERNAL	0.01	2.29	-1.25	268.	278.
Z AXIS EXTERNAL	0.01	5.33	-2.18	46.	125.
RESULTANT	0.03	16.32	0.03	83.	0.
NORM RESULTANT	0.00	1.62	0.00	83.	0.
LUMBAR ACCELERATION (G)					
X AXIS EXTERNAL	0.12	2.29	-13.21	188.	95.
Y AXIS EXTERNAL	0.00	1.08	-1.08	68.	137.
Z AXIS EXTERNAL	0.88	16.41	-2.26	86.	182.
RESULTANT	0.49	20.83	0.17	94.	132.
NORM RESULTANT	0.09	2.05	0.02	94.	132.
SHOULDER LOADS (LB)					
TENSION	145.44	944.23	51.73	88.	195.
LEFT TENSION GRA	35.47	204.79	20.38	89.	179.
RIGHT TENSION GRA	24.54	171.56	18.43	86.	298.
LEG LOADS (LB)					
ANCHOR LOADS (LB)					
LEFT 45 DEG X AXIS	22.10	869.48	22.10	92.	0.
LEFT 45 DEG Y AXIS	2.10	92.78	-1.18	93.	209.
LEFT 45 DEG Z AXIS	13.40	380.66	10.66	90.	431.
LEFT 45 DEG RESULTANT	25.98	770.39	24.57	92.	443.
RIGHT 45 DEG X AXIS	18.83	851.22	18.31	91.	2.
RIGHT 45 DEG Y AXIS	2.85	109.35	-1.10	89.	212.
RIGHT 45 DEG Z AXIS	20.78	454.14	18.50	91.	0.
RIGHT 45 DEG RESULTANT	28.06	801.25	27.85	91.	0.
AT VERTICAL X AXIS	-18.38	118.21	-16.98	92.	2.
AT VERTICAL Y AXIS	0.75	4.93	-5.89	92.	55.
AT VERTICAL Z AXIS	72.02	281.48	31.32	91.	43.
AT VERTICAL RESULTANT	73.87	287.00	31.78	92.	43.
SEAT LOADS (LB)					
LEFT LINK X AXIS	10.85	87.88	-183.77	159.	92.
RIGHT LINK X AXIS	30.51	99.18	-139.91	194.	92.
X AXIS SUM	41.36	157.32	-333.68	177.	92.
X AXIS MINUS TARE	41.70	151.97	-186.04	185.	92.
CENTER LINK Y AXIS	84.98	85.18	-108.68	0.	93.
LEFT Z AXIS	40.88	808.29	13.02	93.	301.
RIGHT Z AXIS	37.37	810.58	20.93	95.	223.
CENTER Z AXIS	171.19	1194.20	173.57	94.	0.
Z AXIS SUM	249.25	2809.98	252.46	94.	0.
Z AXIS MINUS TARE	249.08	2725.88	250.03	95.	1.
RESULTANT	280.87	2831.37	283.48	94.	1.
RESULTANT MINUS TARE	280.75	2734.02	281.98	95.	1.

CREST STUDY -GX TEST: 3131 SUBJ: K-2 WT: 187.0 NOM G: 10.0 CELL: B

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK					
2.5V EXT PWR		2.50	2.50	-179.	0.
10V EXT PWR		10.01	9.99	49.	38.
SLED ACCELERATION (G)					
X AXIS	-0.01	0.49	-9.87	160.	58.
Y AXIS	0.00	0.29	-0.30	279.	126.
Z AXIS	1.00	2.49	-0.69	57.	52.
SEAT ACCELERATION (G)					
X AXIS	0.13	2.06	-10.46	161.	51.
Y AXIS	0.00	1.28	-1.47	182.	174.
Z AXIS	0.87	8.18	-0.35	57.	203.
SLED VELOCITY (FT/S)	0.00	30.11	0.00	156.	0.
CHEST ACCELERATION (G)					
X AXIS EXTERNAL	0.09	2.01	-11.29	188.	79.
Y AXIS EXTERNAL	0.03	3.41	-1.39	92.	160.
Z AXIS EXTERNAL	0.88	11.82	-1.95	102.	209.
RESULTANT	0.89	13.82	0.20	79.	174.
NORM RESULTANT	0.09	1.40	0.02	79.	174.
HEAD ACCELERATION (G)					
X AXIS EXTERNAL	0.03	2.20	-8.57	233.	101.
Y AXIS EXTERNAL	0.06	0.44	-1.06	145.	86.
Z AXIS EXTERNAL	0.81	3.84	-13.38	180.	92.
RESULTANT	0.81	15.47	0.41	95.	200.
NORM RESULTANT	0.08	1.57	0.04	95.	200.
AT EXTERNAL	-5.39	393.72	-187.36	126.	97.
THORAX ACCELERATION (G)					
X AXIS EXTERNAL	-0.01	1.55	-19.98	184.	89.
Y AXIS EXTERNAL	0.00	1.74	-2.43	191.	97.
Z AXIS EXTERNAL	0.00	3.80	-2.66	53.	118.
RESULTANT	0.03	14.09	0.04	89.	0.
NORM RESULTANT	0.00	1.43	0.00	89.	0.
LUMBAR ACCELERATION (G)					
X AXIS EXTERNAL	0.12	1.78	-12.52	184.	82.
Y AXIS EXTERNAL	0.00	7.28	-1.50	88.	187.
Z AXIS EXTERNAL	0.87	9.32	-0.44	87.	38.
RESULTANT	0.88	18.41	0.28	84.	245.
NORM RESULTANT	0.08	1.66	0.03	84.	245.
SHOULDER LOADS (LB)					
TENSION	125.48	775.38	45.72	60.	217.
LEFT TENSION GAA	39.28	173.58	15.18	61.	174.
RIGHT TENSION GAA	42.22	202.01	32.34	64.	182.
WELDS (LB)					
LEFT TENSION WAA	29.88	189.08	19.90	89.	188.
RIGHT TENSION WAA	21.53	180.89	18.57	85.	180.
ANCHOR LOADS (LB)					
LEFT 45 DEG X AXIS	42.88	581.53	34.81	88.	419.
LEFT 45 DEG Y AXIS	5.05	84.18	-1.95	88.	211.
LEFT 45 DEG Z AXIS	28.88	359.29	19.17	85.	209.
LEFT 45 DEG RESULTANT	50.88	669.72	39.88	86.	429.
RIGHT 45 DEG X AXIS	37.92	526.19	20.28	87.	414.
RIGHT 45 DEG Y AXIS	4.32	77.68	-0.67	84.	216.
RIGHT 45 DEG Z AXIS	44.22	392.22	20.21	86.	430.
RIGHT 45 DEG RESULTANT	58.44	859.42	28.70	87.	430.
AT VERTICAL X AXIS	-8.33	93.57	-8.18	103.	1.
AT VERTICAL Y AXIS	8.88	10.09	-0.67	88.	58.
AT VERTICAL Z AXIS	75.79	127.00	17.88	114.	46.
AT VERTICAL RESULTANT	78.22	218.25	22.80	114.	46.
SEAT LOADS (LB)					
LEFT LINK X AXIS	38.23	83.01	-171.91	288.	84.
RIGHT LINK X AXIS	5.91	72.08	-151.85	425.	90.
X AXIS SUM	42.14	129.10	-321.36	412.	90.
X AXIS MINUS TARE	42.18	124.50	-189.81	420.	90.
CENTER LINK Y AXIS	-87.23	-18.01	-217.39	227.	90.
LEFT Z AXIS	43.68	735.18	11.22	89.	278.
RIGHT Z AXIS	75.21	709.90	5.42	91.	411.
CENTER Z AXIS	252.39	1069.37	252.87	85.	1.
Z AXIS SUM	371.28	2508.71	309.58	92.	237.
Z AXIS MINUS TARE	371.14	2414.09	314.20	92.	239.
RESULTANT	383.89	2538.20	314.85	92.	237.
RESULTANT MINUS TARE	383.58	2430.14	324.57	92.	239.

CREST STUDY -GX TEST: 3132 SUBJ: M20 WT: 192.0 NOM G: 10.0 CELL: B

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK					
2.5V EXT PMA		2.50	2.49	-186.	
10V EXT PMA		10.01	9.98	21.	85.
SLED ACCELERATION (G)					
X AXIS	-0.01	0.52	-9.89	159.	57.
Y AXIS	0.00	0.36	-0.38	266.	324.
Z AXIS	1.00	2.45	-0.73	55.	51.
SEAT ACCELERATION (G)					
X AXIS	0.12	2.21	-10.41	160.	50.
Y AXIS	0.00	1.22	-1.97	181.	179.
Z AXIS	0.87	8.08	-0.41	56.	167.
SLED VELOCITY (FT/S)	0.00	29.95	0.00	162.	0.
CHEST ACCELERATION (G)					
X AXIS EXTERNAL	0.12	4.12	-13.54	188.	104.
Y AXIS EXTERNAL	0.00	5.60	-2.42	95.	156.
Z AXIS EXTERNAL	0.88	10.29	-2.44	95.	158.
RESULTANT	0.89	17.46	0.07	95.	215.
NORM RESULTANT	0.09	1.77	0.01	95.	215.
HEAD ACCELERATION (G)					
X AXIS EXTERNAL	0.19	2.58	-12.75	261.	104.
Y AXIS EXTERNAL	-0.02	0.90	-1.20	245.	191.
Z AXIS EXTERNAL	0.89	4.73	-14.93	177.	94.
RESULTANT	0.91	18.68	0.41	98.	25.
NORM RESULTANT	0.09	1.89	0.04	98.	25.
AT EXTERNAL	-0.12	642.79	-430.83	127.	232.
THORAX ACCELERATION (G)					
X AXIS EXTERNAL	-0.01	2.61	-14.08	186.	91.
Y AXIS EXTERNAL	-0.01	1.88	-2.09	183.	98.
Z AXIS EXTERNAL	0.00	4.75	-1.41	49.	88.
RESULTANT	0.05	14.21	0.03	91.	1.
NORM RESULTANT	0.00	1.44	0.00	91.	1.
LUMBAR ACCELERATION (G)					
X AXIS EXTERNAL	0.11	4.42	-13.32	184.	77.
Y AXIS EXTERNAL	0.00	3.10	-1.48	58.	216.
Z AXIS EXTERNAL	0.86	14.61	-6.05	59.	182.
RESULTANT	0.87	18.87	0.40	76.	206.
NORM RESULTANT	0.09	1.89	0.04	76.	206.
SHOULDER LOADS (LB)					
TENSION	54.87	998.60	52.88	89.	0.
LEFT TENSION ORA	36.84	231.41	28.09	87.	379.
RIGHT TENSION ORA	33.98	269.00	33.89	86.	0.
LEG LOADS (LB)					
ANCHOR LOADS (LB)					
LEFT 45 DEG X AXIS	38.81	813.38	37.14	88.	0.
LEFT 45 DEG Y AXIS	0.87	40.11	-3.87	86.	186.
LEFT 45 DEG Z AXIS	23.59	385.72	22.81	86.	3.
LEFT 45 DEG RESULTANT	43.83	725.70	44.73	86.	0.
RIGHT 45 DEG X AXIS	28.55	584.89	27.57	88.	0.
RIGHT 45 DEG Y AXIS	3.84	40.93	-0.26	84.	176.
RIGHT 45 DEG Z AXIS	28.95	437.01	28.29	86.	1.
RIGHT 45 DEG RESULTANT	38.49	734.15	39.67	89.	1.
AT VERTICAL X AXIS	-1.20	135.10	-2.30	90.	3.
AT VERTICAL Y AXIS	9.85	10.93	-0.90	85.	58.
AT VERTICAL Z AXIS	48.17	285.44	6.10	91.	40.
AT VERTICAL RESULTANT	48.34	315.98	14.93	82.	35.
SEAT LOADS (LB)					
LEFT LINK X AXIS	30.08	110.04	-158.61	182.	83.
RIGHT LINK X AXIS	-2.81	72.22	-157.54	349.	92.
X AXIS SUM	27.46	149.77	-310.17	337.	90.
X AXIS MINUS TARE	27.75	145.80	-171.01	340.	89.
CENTER LINK Y AXIS	-80.09	-16.29	-243.93	227.	81.
LEFT Z AXIS	19.73	735.77	8.71	86.	193.
RIGHT Z AXIS	16.84	728.28	24.90	91.	350.
CENTER Z AXIS	184.86	1224.39	185.20	80.	0.
Z AXIS SUM	301.34	2680.24	304.02	80.	0.
Z AXIS MINUS TARE	301.26	2588.79	302.61	81.	0.
RESULTANT	308.48	2708.79	311.18	80.	0.
RESULTANT MINUS TARE	308.44	2604.95	310.14	81.	0.

CREST STUDY -GX TEST: 9133 SUBJ: M18 WT: 198.0 NOM G: 10.0 CELL: 8

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK					
2.5V EXT PWR		2.50	2.50	-180.	2.
10V EXT PWR		10.01	9.99	25.	6.
SLED ACCELERATION (G)					
X AXIS	-0.01	0.44	-9.92	159.	57.
Y AXIS	0.00	0.20	-0.30	274.	125.
Z AXIS	1.00	2.52	-0.66	56.	51.
SEAT ACCELERATION (G)					
X AXIS	0.13	2.35	-10.49	159.	50.
Y AXIS	0.00	1.14	-1.25	225.	172.
Z AXIS	0.87	8.18	-0.31	56.	202.
SLED VELOCITY (FT/S)	0.00	29.98	0.00	162.	0.
CHEST ACCELERATION (G)					
X AXIS EXTERNAL	0.14	9.12	-10.85	169.	98.
Y AXIS EXTERNAL	-0.01	5.32	-4.34	98.	195.
Z AXIS EXTERNAL	0.86	18.20	-8.86	107.	187.
RESULTANT	0.87	18.95	0.24	107.	234.
NORM RESULTANT	0.09	1.91	0.02	107.	234.
HEAD ACCELERATION (G)					
X AXIS EXTERNAL	0.09	9.04	-9.73	271.	90.
Y AXIS EXTERNAL	0.01	0.52	-0.59	81.	131.
Z AXIS EXTERNAL	0.37	2.95	-18.07	139.	89.
RESULTANT	0.87	20.53	0.08	91.	198.
NORM RESULTANT	0.09	2.07	0.01	91.	198.
AT EXTERNAL	0.13	598.18	-445.05	128.	85.
THORAX ACCELERATION (G)					
X AXIS EXTERNAL	-0.01	1.78	-14.45	205.	85.
Y AXIS EXTERNAL	0.01	1.18	-2.29	210.	49.
Z AXIS EXTERNAL	0.00	4.88	-9.62	55.	100.
RESULTANT	0.04	14.55	0.03	85.	0.
NORM RESULTANT	0.00	1.47	0.00	85.	0.
LUMBAR ACCELERATION (G)					
X AXIS EXTERNAL	0.13	4.72	-14.22	181.	79.
Y AXIS EXTERNAL	0.01	7.81	-4.95	72.	170.
Z AXIS EXTERNAL	0.87	13.35	-2.49	74.	174.
RESULTANT	0.89	19.04	0.47	76.	314.
NORM RESULTANT	0.09	1.82	0.05	76.	314.
SHOULDER LOADS (LB)					
TENSION	88.13	895.78	43.97	94.	234.
LEFT TENSION QAR	35.48	187.98	-3.55	85.	21.
RIGHT TENSION QAR	39.92	294.88	35.63	83.	181.
LEG LOADS (LB)					
ANCHOR LOADS (LB)					
LEFT 45 DEG X AXIS	40.88	599.50	27.19	85.	333.
LEFT 45 DEG Y AXIS	1.85	39.05	-2.00	86.	186.
LEFT 45 DEG Z AXIS	28.91	389.03	12.82	85.	336.
LEFT 45 DEG RESULTANT	50.09	704.70	31.12	85.	333.
RIGHT 45 DEG X AXIS	34.78	557.53	20.89	85.	198.
RIGHT 45 DEG Y AXIS	1.82	42.28	-5.24	85.	175.
RIGHT 45 DEG Z AXIS	38.79	393.84	16.74	85.	195.
RIGHT 45 DEG RESULTANT	50.86	683.80	28.39	85.	198.
AT VERTICAL X AXIS	2.14	117.81	0.35	112.	3.
AT VERTICAL Y AXIS	2.45	7.28	-2.39	85.	57.
AT VERTICAL Z AXIS	34.51	225.48	-0.75	113.	37.
AT VERTICAL RESULTANT	34.88	253.48	10.73	114.	32.
SEAT LOADS (LB)					
LEFT LINK X AXIS	19.48	57.30	-190.88	385.	89.
RIGHT LINK X AXIS	15.08	48.68	-141.45	195.	84.
X AXIS SUM	28.52	101.21	-931.18	179.	83.
X AXIS MINUS TARE	28.57	96.94	-180.27	188.	88.
CENTER LINK Y AXIS	-58.79	-14.25	-238.89	336.	79.
LEFT Z AXIS	54.20	704.70	11.75	83.	345.
RIGHT Z AXIS	65.79	647.59	8.89	84.	203.
CENTER Z AXIS	158.51	1105.82	182.31	88.	0.
Z AXIS SUM	278.50	2447.09	258.58	83.	203.
Z AXIS MINUS TARE	278.42	2364.54	265.29	84.	204.
RESULTANT	288.08	2480.53	269.85	83.	203.
RESULTANT MINUS TARE	285.89	2382.12	278.82	84.	204.

CREST STUDY -GX TEST: 9134 SUBJ: A-8 WT: 170.0 NOM G: 10.0 CELL: 8

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK				-177.	
2.5V EXT PNA		2.50	2.50	0.	24.
10V EXT PNA		10.01	9.99	3.	23.
SLED ACCELERATION (G)					
X AXIS	-0.01	0.47	-9.98	176.	57.
Y AXIS	0.00	0.28	-0.37	146.	113.
Z AXIS	1.00	2.46	-0.58	56.	51.
SEAT ACCELERATION (G)					
X AXIS	0.13	2.41	-10.56	158.	50.
Y AXIS	0.00	1.42	-1.49	259.	252.
Z AXIS	0.87	7.91	-0.60	56.	163.
SLED VELOCITY (FT/S)	0.00	30.14	0.00	158.	0.
CHEST ACCELERATION (G)					
X AXIS EXTERNAL	0.13	2.97	-17.10	163.	87.
Y AXIS EXTERNAL	-0.01	4.73	-2.05	87.	132.
Z AXIS EXTERNAL	0.87	8.29	-1.93	112.	225.
RESULTANT	0.88	19.02	0.22	87.	212.
NORM RESULTANT	0.09	1.91	0.02	87.	212.
HEAD ACCELERATION (G)					
X AXIS EXTERNAL	0.15	1.69	-0.27	260.	105.
Y AXIS EXTERNAL	0.01	0.68	-1.18	91.	151.
Z AXIS EXTERNAL	0.91	4.40	-18.27	176.	90.
RESULTANT	0.92	19.30	0.78	92.	222.
NORM RESULTANT	0.09	1.94	0.08	92.	222.
AT EXTERNAL	2.30	460.86	-471.24	153.	102.
THORAX ACCELERATION (G)					
X AXIS EXTERNAL	0.01	1.38	-15.34	193.	85.
Y AXIS EXTERNAL	0.00	1.32	-2.83	243.	81.
Z AXIS EXTERNAL	0.00	4.38	-2.96	46.	78.
RESULTANT	0.04	15.54	0.06	84.	429.
NORM RESULTANT	0.00	1.56	0.01	84.	429.
LUMBAR ACCELERATION (G)					
X AXIS EXTERNAL	0.12	1.30	-11.38	185.	80.
Y AXIS EXTERNAL	0.00	9.39	-2.05	97.	23.
Z AXIS EXTERNAL	0.87	17.12	-0.65	95.	178.
RESULTANT	0.88	21.73	0.21	95.	260.
NORM RESULTANT	0.09	2.18	0.02	95.	260.
SHOULDER LOADS (LB)					
TENSION	75.77	841.08	20.60	87.	233.
LEFT TENSION QAA	38.05	220.91	19.95	80.	182.
RIGHT TENSION QAA	32.20	194.78	25.11	80.	176.
LEG LOADS (LB)					
ANCHOR LOADS (LB)					
LEFT 45 DEG X AXIS	19.29	638.60	20.88	88.	0.
LEFT 45 DEG Y AXIS	2.14	67.27	-2.32	87.	241.
LEFT 45 DEG Z AXIS	8.51	383.85	7.45	87.	0.
LEFT 45 DEG RESULTANT	21.22	736.12	22.29	88.	0.
RIGHT 45 DEG X AXIS	20.14	597.35	21.79	88.	0.
RIGHT 45 DEG Y AXIS	3.97	101.88	0.41	86.	214.
RIGHT 45 DEG Z AXIS	24.56	415.98	24.38	87.	0.
RIGHT 45 DEG RESULTANT	32.03	733.34	32.98	87.	0.
AT VERTICAL X AXIS	-1.91	137.54	-2.08	109.	1.
AT VERTICAL Y AXIS	1.73	10.00	-2.90	87.	57.
AT VERTICAL Z AXIS	52.84	265.22	5.55	102.	46.
AT VERTICAL RESULTANT	52.81	287.88	12.52	102.	46.
SEAT LOADS (LB)					
LEFT LINK X AXIS	25.68	82.40	-173.00	159.	91.
RIGHT LINK X AXIS	27.60	47.47	-174.13	195.	90.
X AXIS SUM	49.29	113.35	-345.98	177.	91.
X AXIS MINUS TARE	49.42	108.57	-206.05	49.	90.
CENTER LINK Y AXIS	-48.85	6.38	-216.28	224.	91.
LEFT Z AXIS	20.08	734.03	0.78	91.	250.
RIGHT Z AXIS	50.92	805.18	27.93	91.	224.
CENTER Z AXIS	172.82	1168.10	172.50	93.	235.
Z AXIS SUM	243.83	2689.12	205.93	92.	233.
Z AXIS MINUS TARE	243.76	2598.25	214.54	92.	237.
RESULTANT	253.31	2719.74	213.43	92.	234.
RESULTANT MINUS TARE	253.47	2815.01	223.01	92.	237.

CREST STUDY -GX TEST: 3071 SUBJ: L-3 WT: 185.0 NOM G: 10.0 CELL: B

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK					
2.5V EXT PWR		2.50	2.50	83.	
10V EXT PWR		10.01	9.99	9.	22.
SLED ACCELERATION (G)					
X AXIS	-0.02	0.50	-9.85	157.	56.
Y AXIS	0.00	0.41	-0.34	242.	122.
Z AXIS	1.00	2.35	-0.59	56.	51.
SEAT ACCELERATION (G)					
X AXIS	0.11	2.71	-10.35	158.	49.
Y AXIS	0.00	1.58	-1.55	178.	171.
Z AXIS	0.88	7.94	-0.50	56.	164.
SLED VELOCITY (FT/S)	0.00	30.54	0.00	156.	0.
CHEST ACCELERATION (G)					
X AXIS EXTERNAL	0.11	8.87	-15.05	131.	79.
Y AXIS EXTERNAL	0.01	6.31	-7.98	103.	126.
Z AXIS EXTERNAL	0.88	11.72	-2.24	133.	170.
RESULTANT	0.88	16.77	0.38	78.	258.
NORM RESULTANT	0.09	1.70	0.04	78.	258.
HEAD ACCELERATION (G)					
X AXIS EXTERNAL	0.12	1.52	-11.40	278.	103.
Y AXIS EXTERNAL	0.00	0.80	-0.74	105.	190.
Z AXIS EXTERNAL	0.78	5.09	-13.05	174.	88.
RESULTANT	0.79	18.79	0.22	88.	209.
NORM RESULTANT	0.08	1.70	0.02	88.	209.
AY EXTERNAL	-7.91	706.74	-375.79	132.	78.
LUMBAR ACCELERATION (G)					
X AXIS EXTERNAL	0.12	9.44	-12.01	193.	84.
Y AXIS EXTERNAL	-0.01	2.66	-2.26	70.	84.
Z AXIS EXTERNAL	0.89	20.82	-4.02	71.	185.
RESULTANT	0.89	22.72	0.15	71.	235.
NORM RESULTANT	0.09	2.31	0.02	71.	235.
SHOULDER LOADS (LB)					
TENSION	89.88	808.59	89.27	88.	195.
LEFT TENSION ORA	48.87	241.71	29.03	85.	173.
RIGHT TENSION ORA	48.44	286.35	41.54	85.	175.
LEG LOADS (LB)					
LEFT TENSION ORA	24.81	248.55	21.87	85.	170.
RIGHT TENSION ORA	32.12	210.91	28.15	85.	509.
ANCHOR LOADS (LB)					
LEFT 45 DEG X AXIS	32.44	512.82	31.30	85.	177.
LEFT 45 DEG Y AXIS	5.80	71.33	1.74	85.	203.
LEFT 45 DEG Z AXIS	18.17	300.87	9.01	83.	181.
LEFT 45 DEG RESULTANT	38.79	598.83	33.41	85.	189.
RIGHT 45 DEG X AXIS	28.04	478.18	21.47	84.	495.
RIGHT 45 DEG Y AXIS	5.49	85.15	2.67	83.	174.
RIGHT 45 DEG Z AXIS	28.27	347.82	19.87	86.	470.
RIGHT 45 DEG RESULTANT	37.42	597.11	29.52	86.	495.
AT VERTICAL X AXIS	-1.25	67.11	-1.80	94.	0.
AT VERTICAL Y AXIS	3.52	7.59	-1.07	185.	74.
AT VERTICAL Z AXIS	61.20	234.77	32.14	88.	41.
AT VERTICAL RESULTANT	61.32	244.17	33.58	94.	41.
SEAT LOADS (LB)					
LEFT LINK X AXIS	20.18	83.80	-194.49	138.	83.
RIGHT LINK X AXIS	23.45	58.91	-89.37	513.	82.
X AXIS SUM	43.63	118.30	-293.86	315.	83.
X AXIS MINUS TARE	44.13	114.22	-142.47	310.	88.
CENTER LINK Y AXIS	46.33	48.88	-167.53	209.	89.
LEFT Z AXIS	78.40	743.21	58.48	88.	198.
RIGHT Z AXIS	28.84	553.78	-3.62	79.	208.
CENTER Z AXIS	200.44	1101.17	201.18	88.	0.
Z AXIS SUM	308.68	2382.86	308.78	88.	1.
Z AXIS MINUS TARE	308.42	2290.87	308.01	88.	1.
RESULTANT	315.18	2404.82	318.08	88.	1.
RESULTANT MINUS TARE	314.99	2301.38	314.91	88.	1.

CREST STUDY -GX TEST: 3072 SUBJ: 0-3 WT: 214.0 NOM G: 10.0 CELL: 8

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK					
2.5V EXT PWA		2.50	2.50	-82.	107.
10V EXT PWA		10.01	9.99	8.	23.
SLED ACCELERATION (G)					
X AXIS	-0.02	0.62	-9.98	157.	55.
Y AXIS	0.00	0.38	-0.34	290.	320.
Z AXIS	1.00	2.57	-0.66	54.	49.
SEAT ACCELERATION (G)					
X AXIS	0.12	2.36	-10.54	159.	48.
Y AXIS	0.00	1.58	-1.50	180.	172.
Z AXIS	0.88	8.14	-0.53	54.	165.
SLED VELOCITY (FT/S)	0.00	30.66	0.00	157.	0.
CHEST ACCELERATION (G)					
X AXIS EXTERNAL	0.12	2.17	-14.17	175.	79.
Y AXIS EXTERNAL	-0.01	3.20	-0.90	94.	213.
Z AXIS EXTERNAL	0.85	10.16	-1.29	57.	238.
RESULTANT	0.88	16.05	0.28	79.	232.
NORM RESULTANT	0.08	1.81	0.03	79.	232.
HEAD ACCELERATION (G)					
X AXIS EXTERNAL	0.12	2.85	-12.26	261.	100.
Y AXIS EXTERNAL	-0.01	1.45	-0.94	207.	275.
Z AXIS EXTERNAL	0.88	3.20	-12.37	341.	95.
RESULTANT	0.89	17.13	0.16	96.	20.
NORM RESULTANT	0.09	1.72	0.02	96.	20.
RY EXTERNAL	2.23	479.85	-348.05	126.	241.
LUMBAR ACCELERATION (G)					
X AXIS EXTERNAL	0.11	4.13	-14.90	193.	79.
Y AXIS EXTERNAL	-0.01	4.30	-4.04	78.	72.
Z AXIS EXTERNAL	0.88	33.38	-5.29	74.	180.
RESULTANT	0.88	35.35	0.29	74.	255.
NORM RESULTANT	0.09	3.54	0.03	74.	255.
SHOULDER LOADS (LB)					
TENSION	98.52	1037.31	18.54	88.	196.
LEFT TENSION GRA	58.53	242.86	36.98	82.	180.
RIGHT TENSION GRA	53.23	281.78	43.83	84.	174.
LEG LOADS (LB)					
LEFT TENSION GRA	25.20	220.62	24.90	85.	3.
RIGHT TENSION GRA	23.24	174.84	20.87	83.	173.
ANCHOR LOADS (LB)					
LEFT 45 DEG X AXIS	42.08	545.90	1.22	84.	281.
LEFT 45 DEG Y AXIS	2.88	10.35	-7.05	110.	55.
LEFT 45 DEG Z AXIS	21.15	904.00	-8.55	89.	273.
LEFT 45 DEG RESULTANT	47.19	824.84	7.34	84.	304.
RIGHT 45 DEG X AXIS	32.38	507.98	0.00	86.	292.
RIGHT 45 DEG Y AXIS	2.75	51.71	-3.52	83.	162.
RIGHT 45 DEG Z AXIS	32.11	348.05	3.86	85.	275.
RIGHT 45 DEG RESULTANT	45.70	618.50	4.28	87.	292.
AT VERTICAL X AXIS	8.48	130.80	6.69	92.	4.
AT VERTICAL Y AXIS	2.19	8.41	-1.12	168.	55.
AT VERTICAL Z AXIS	87.91	255.35	21.25	92.	44.
AT VERTICAL RESULTANT	88.35	286.92	32.44	92.	44.
SEAT LOADS (LB)					
LEFT LINK X AXIS	18.28	91.54	-207.24	177.	79.
RIGHT LINK X AXIS	38.01	61.65	-89.97	283.	80.
X AXIS SUM	56.29	143.55	-297.21	520.	81.
X AXIS MINUS TARE	56.88	139.88	-141.10	512.	86.
CENTER LINK Y AXIS	-31.70	14.56	-234.97	514.	76.
LEFT Z AXIS	71.38	821.03	7.18	84.	510.
RIGHT Z AXIS	48.41	642.88	3.44	88.	211.
CENTER Z AXIS	293.83	1186.34	295.81	78.	1.
Z AXIS SUM	414.61	2510.05	366.62	87.	211.
Z AXIS MINUS TARE	414.41	2511.52	370.35	88.	213.
RESULTANT	419.82	2839.43	380.59	87.	222.
RESULTANT MINUS TARE	419.48	2524.22	385.21	87.	225.



CREST STUDY -GX TEST: 3087 SUBJ: K-3 WT: 135.0 NOM G: 10.0 CELL: 8

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK				-110.	
2.5V EXT PHA		2.50	2.50	19.	448.
10V EXT PHA		10.01	9.99	0.	42.
SLED ACCELERATION (G)					
X AXIS	-0.01	0.52	-10.00	175.	58.
Y AXIS	0.00	0.30	-0.23	174.	120.
Z AXIS	1.00	2.30	-0.58	57.	53.
SEAT ACCELERATION (G)					
X AXIS	0.12	2.23	-10.50	156.	51.
Y AXIS	0.00	1.23	-1.58	178.	189.
Z AXIS	0.87	7.89	-0.93	58.	161.
SLED VELOCITY (FT/S)	0.00	30.80	0.00	158.	0.
CHEST ACCELERATION (G)					
X AXIS EXTERNAL	0.12	1.90	-14.88	188.	82.
Y AXIS EXTERNAL	0.00	9.29	-5.31	95.	89.
Z AXIS EXTERNAL	0.88	21.05	-1.50	98.	188.
RESULTANT	0.89	25.04	0.32	96.	349.
NORM RESULTANT	0.09	2.50	0.03	96.	349.
HEAD ACCELERATION (G)					
X AXIS EXTERNAL	0.13	1.81	-8.05	181.	82.
Y AXIS EXTERNAL	-0.01	2.48	-0.49	84.	302.
Z AXIS EXTERNAL	0.83	4.12	-18.50	186.	80.
RESULTANT	0.84	20.27	0.78	81.	9.
NORM RESULTANT	0.08	2.03	0.08	81.	9.
RY EXTERNAL	-1.11	450.41	-404.98	130.	69.
LUMBAR ACCELERATION (G)					
X AXIS EXTERNAL	0.13	2.40	-12.80	181.	82.
Y AXIS EXTERNAL	0.00	1.66	-3.42	437.	98.
Z AXIS EXTERNAL	0.82	14.76	-1.97	68.	43.
RESULTANT	0.87	17.44	0.52	69.	353.
NORM RESULTANT	0.09	1.74	0.05	69.	353.
SHOULDER LOADS (LB)					
TENSION	70.03	777.88	23.17	86.	194.
LEFT TENSION QRA	28.64	160.67	18.82	80.	178.
RIGHT TENSION QRA	29.94	197.83	28.16	80.	8.
LEG LOADS (LB)					
LEFT TENSION QRA	12.12	182.45	12.21	83.	0.
RIGHT TENSION QRA	13.47	150.77	12.20	81.	6.
ANCHOR LOADS (LB)					
LEFT 45 DEG X AXIS	19.38	399.35	16.50	87.	328.
LEFT 45 DEG Y AXIS	3.73	77.98	-0.81	86.	208.
LEFT 45 DEG Z AXIS	10.65	254.95	6.76	86.	197.
LEFT 45 DEG RESULTANT	22.46	480.17	19.00	80.	328.
RIGHT 45 DEG X AXIS	11.74	383.18	10.41	87.	0.
RIGHT 45 DEG Y AXIS	1.40	60.78	-3.44	87.	193.
RIGHT 45 DEG Z AXIS	14.50	281.45	9.78	88.	195.
RIGHT 45 DEG RESULTANT	18.75	478.31	15.85	88.	210.
AT VERTICAL X AXIS	-5.32	88.87	-6.43	94.	0.
AT VERTICAL Y AXIS	0.80	4.85	-5.03	183.	59.
AT VERTICAL Z AXIS	33.11	226.43	8.10	91.	38.
AT VERTICAL RESULTANT	33.57	241.86	9.32	91.	37.
SEAT LOADS (LB)					
LEFT LINK X AXIS	43.93	42.21	-158.98	0.	84.
RIGHT LINK X AXIS	19.78	19.22	-126.57	0.	83.
X AXIS SUM	63.08	61.43	-285.54	0.	84.
X AXIS MINUS TARE	63.28	99.11	-133.70	38.	93.
CENTER LINK Y AXIS	-38.28	-4.99	-153.83	229.	92.
LEFT Z AXIS	21.71	471.39	15.83	84.	309.
RIGHT Z AXIS	31.64	500.86	2.11	93.	212.
CENTER Z AXIS	118.88	775.83	117.18	83.	1.
Z AXIS SUM	170.03	1743.93	172.08	93.	2.
Z AXIS MINUS TARE	169.94	1655.30	169.45	93.	2.
RESULTANT	184.85	1771.01	175.25	93.	232.
RESULTANT MINUS TARE	184.84	1667.80	177.59	93.	232.

CREST STUDY -GX TEST: 3080 SUBJ: M19 WT: 184.0 NOM G: 10.0 CELL: B

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK					
2.5V EXT PNA		2.50	2.50	-105.	0.
10V EXT PNA		10.01	9.99	12.	29.
SLED ACCELERATION (G)					
X AXIS	-0.02	0.48	-10.01	175.	56.
Y AXIS	0.00	0.32	-0.41	240.	116.
Z AXIS	1.00	2.32	-0.57	56.	51.
SEAT ACCELERATION (G)					
X AXIS	0.12	2.34	-10.49	156.	50.
Y AXIS	0.00	1.43	-1.24	248.	169.
Z AXIS	0.87	8.00	-0.26	56.	161.
SLED VELOCITY (FT/S)	0.00	30.32	0.00	155.	0.
CHEST ACCELERATION (G)					
X AXIS EXTERNAL	0.01	3.41	-18.48	187.	90.
Y AXIS EXTERNAL	0.12	2.15	-1.33	112.	79.
Z AXIS EXTERNAL	0.87	9.98	-2.80	101.	232.
RESULTANT	0.88	17.88	0.42	91.	249.
NORM RESULTANT	0.09	1.79	0.04	91.	249.
HEAD ACCELERATION (G)					
X AXIS EXTERNAL	0.12	2.51	-11.45	281.	112.
Y AXIS EXTERNAL	0.00	0.84	-0.98	233.	109.
Z AXIS EXTERNAL	0.84	3.52	-18.66	188.	93.
RESULTANT	0.85	18.44	0.85	97.	19.
NORM RESULTANT	0.08	1.84	0.06	97.	19.
AT EXTERNAL	-1.12	609.46	-325.58	138.	105.
LUMBAR ACCELERATION (G)					
X AXIS EXTERNAL	0.11	2.84	-11.88	173.	87.
Y AXIS EXTERNAL	0.00	2.38	-2.77	105.	22.
Z AXIS EXTERNAL	0.87	12.57	-3.95	105.	23.
RESULTANT	0.88	16.61	0.42	89.	205.
NORM RESULTANT	0.09	1.88	0.04	89.	205.
SHOULDER LOADS (LB)					
TENSION	62.33	831.71	14.15	88.	290.
LEFT TENSION QRA	31.95	204.27	17.50	85.	163.
RIGHT TENSION QRA	28.65	215.19	26.13	83.	0.
LEG LOADS (LB)					
LEFT TENSION QRA	14.63	238.16	19.69	86.	1.
RIGHT TENSION QRA	12.50	197.17	11.23	86.	8.
ANCHOR LOADS (LB)					
LEFT 45 DEG X AXIS	15.33	807.91	13.89	91.	1.
LEFT 45 DEG Y AXIS	2.03	67.96	-1.62	87.	183.
LEFT 45 DEG Z AXIS	5.58	353.04	3.72	89.	3.
LEFT 45 DEG RESULTANT	16.50	706.15	16.30	91.	1.
RIGHT 45 DEG X AXIS	17.41	605.28	17.41	93.	0.
RIGHT 45 DEG Y AXIS	0.78	54.38	-3.44	82.	173.
RIGHT 45 DEG Z AXIS	20.09	445.18	19.33	91.	0.
RIGHT 45 DEG RESULTANT	26.82	751.77	26.02	93.	0.
AT VERTICAL X AXIS	-4.07	118.08	-6.03	95.	0.
AT VERTICAL Y AXIS	1.48	5.88	-4.00	164.	219.
AT VERTICAL Z AXIS	24.44	297.95	-9.92	97.	55.
AT VERTICAL RESULTANT	24.84	286.88	7.40	97.	33.
SEAT LOADS (LB)					
LEFT LINK X AXIS	12.70	79.89	-202.25	175.	83.
RIGHT LINK X AXIS	17.83	39.70	-141.08	191.	96.
X AXIS SUM	30.33	108.97	-336.18	175.	94.
X AXIS MINUS TARE	30.71	102.08	-196.95	177.	90.
CENTER LINK Y AXIS	-66.63	3.91	-236.24	244.	89.
LEFT Z AXIS	41.70	792.20	9.80	94.	235.
RIGHT Z AXIS	35.98	697.76	13.41	99.	225.
CENTER Z AXIS	138.42	1127.89	138.19	102.	0.
Z AXIS SUM	216.10	2538.18	192.33	97.	233.
Z AXIS MINUS TARE	215.98	2459.47	196.80	97.	233.
RESULTANT	228.17	2588.03	192.85	97.	233.
RESULTANT MINUS TARE	228.08	2477.42	197.47	97.	233.

CREST STUDY -GX TEST: 3107 SUBJ: P-5 WT: 182.0 NOM G: 10.0 CELL: D

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK				-130.	
2.5V EXT PWA		2.50	2.50	25.	19.
10V EXT PWA		10.01	9.99	126.	13.
SLED ACCELERATION (G)					
X AXIS	-0.02	0.54	-9.91	157.	55.
Y AXIS	0.00	0.43	-0.48	188.	293.
Z AXIS	1.00	2.45	-0.68	55.	50.
SEAT ACCELERATION (G)					
X AXIS	0.12	2.38	-10.48	159.	49.
Y AXIS	0.00	1.40	-1.15	225.	172.
Z AXIS	0.87	8.21	-0.88	55.	165.
SLED VELOCITY (FT/S)	0.00	30.51	0.00	156.	0.
CHEST ACCELERATION (G)					
X AXIS EXTERNAL	0.12	1.34	-14.44	178.	91.
Y AXIS EXTERNAL	0.00	3.75	-1.44	79.	178.
Z AXIS EXTERNAL	0.87	9.71	-1.84	71.	210.
RESULTANT	0.88	14.92	0.49	81.	295.
NORM RESULTANT	0.09	1.51	0.05	91.	295.
HEAD ACCELERATION (G)					
X AXIS EXTERNAL	0.19	1.84	-10.58	248.	89.
Y AXIS EXTERNAL	0.03	0.80	-0.67	132.	173.
Z AXIS EXTERNAL	0.87	2.68	-16.07	141.	89.
RESULTANT	0.88	18.41	0.57	89.	20.
NORM RESULTANT	0.09	1.86	0.06	89.	20.
AT EXTERNAL	0.60	463.92	-376.73	141.	68.
THORAX ACCELERATION (G)					
X AXIS EXTERNAL	-0.01	2.53	-14.45	181.	85.
Y AXIS EXTERNAL	0.00	1.75	-2.84	188.	98.
Z AXIS EXTERNAL	0.01	3.56	-3.24	40.	103.
RESULTANT	0.03	14.56	0.04	85.	343.
NORM RESULTANT	0.00	1.47	0.00	85.	343.
LUMBAR ACCELERATION (G)					
X AXIS EXTERNAL	0.13	7.74	-11.85	172.	76.
Y AXIS EXTERNAL	0.00	3.38	-2.23	82.	214.
Z AXIS EXTERNAL	0.88	18.79	-5.81	63.	168.
RESULTANT	0.89	18.18	0.35	83.	44.
NORM RESULTANT	0.09	1.83	0.04	63.	44.
SHOULDER LOADS (LB)					
TENSION	82.17	869.97	24.24	94.	212.
LEFT TENSION QRA	27.57	124.88	13.57	73.	178.
RIGHT TENSION QRA	33.54	171.61	31.03	78.	169.
LEG LOADS (LB)					
ANCHOR LOADS (LB)					
LEFT HORIZ X AXIS	29.59	589.67	23.29	81.	437.
LEFT HORIZ Y AXIS	7.08	65.18	3.71	83.	185.
LEFT HORIZ Z AXIS	-16.75	-14.98	-77.03	408.	81.
LEFT HORIZ RESULTANT	34.73	588.24	28.34	83.	437.
RIGHT HORIZ X AXIS	25.84	557.06	24.54	82.	195.
RIGHT HORIZ Y AXIS	2.27	59.03	-1.94	81.	194.
RIGHT HORIZ Z AXIS	0.81	21.37	-4.33	81.	32.
RIGHT HORIZ RESULTANT	25.75	560.43	24.55	82.	197.
AT VERTICAL X AXIS	8.82	50.68	5.25	90.	0.
AT VERTICAL Y AXIS	7.17	11.01	3.48	165.	55.
AT VERTICAL Z AXIS	84.47	403.36	53.18	89.	18.
AT VERTICAL RESULTANT	65.21	406.43	54.68	88.	18.
SEAT LOADS (LB)					
LEFT LINK X AXIS	24.11	59.37	-170.73	178.	83.
RIGHT LINK X AXIS	17.84	43.41	-125.70	455.	83.
X AXIS SUM	41.95	98.00	-296.44	435.	83.
X AXIS MINUS TARE	42.24	95.28	-150.73	459.	86.
CENTER LINK Y AXIS	-54.82	-11.88	-208.88	224.	79.
LEFT Z AXIS	32.80	595.69	1.95	84.	435.
RIGHT Z AXIS	30.87	532.68	3.16	85.	204.
CENTER Z AXIS	193.30	940.09	182.35	80.	223.
Z AXIS SUM	256.57	2059.18	213.81	85.	223.
Z AXIS MINUS TARE	258.49	1973.04	220.21	83.	216.
RESULTANT	265.89	2080.10	215.74	85.	223.
RESULTANT MINUS TARE	265.86	1988.46	224.08	83.	226.

CREST STUDY -GX TEST: 3146 SUBJ: D-5 WT: 171.0 NOM G: 10.0 CELL: 0

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK				-194.	
2.5V EXT PWA		2.50	2.50	19.	2.
10V EXT PWA		10.01	9.99	33.	1.
SLED ACCELERATION (G)					
X AXIS	-0.01	0.46	-10.02	173.	56.
Y AXIS	0.00	0.30	-0.43	266.	292.
Z AXIS	1.03	2.53	-0.70	55.	50.
SEAT ACCELERATION (G)					
X AXIS	0.19	1.94	-10.61	157.	49.
Y AXIS	0.00	1.23	-0.97	223.	170.
Z AXIS	0.87	8.18	0.07	55.	163.
SLED VELOCITY (FT/S)	0.00	30.42	0.00	159.	0.
CHEST ACCELERATION (G)					
X AXIS EXTERNAL	0.13	7.03	-15.34	82.	80.
Y AXIS EXTERNAL	-0.01	13.83	-3.20	89.	178.
Z AXIS EXTERNAL	0.86	13.47	-3.08	96.	175.
RESULTANT	0.87	18.20	0.40	94.	224.
NORM RESULTANT	0.09	1.82	0.04	94.	224.
HEAD ACCELERATION (G)					
X AXIS EXTERNAL	0.12	2.18	-11.76	227.	98.
Y AXIS EXTERNAL	-0.03	0.82	-0.82	236.	155.
Z AXIS EXTERNAL	0.84	3.14	-14.64	136.	85.
RESULTANT	0.85	18.14	0.18	90.	20.
NORM RESULTANT	0.08	1.81	0.02	90.	20.
AT EXTERNAL	-1.28	538.66	-340.04	129.	78.
THORAX ACCELERATION (G)					
X AXIS EXTERNAL	-0.01	1.85	-13.59	192.	90.
Y AXIS EXTERNAL	0.00	2.27	-3.94	113.	105.
Z AXIS EXTERNAL	0.01	4.54	-4.53	50.	99.
RESULTANT	0.03	13.74	0.04	90.	319.
NORM RESULTANT	0.00	1.97	0.00	90.	319.
LUMBAR ACCELERATION (G)					
X AXIS EXTERNAL	0.13	1.48	-11.05	178.	85.
Y AXIS EXTERNAL	0.01	5.85	-1.28	77.	30.
Z AXIS EXTERNAL	0.88	15.44	-3.27	79.	184.
RESULTANT	0.89	19.52	0.41	78.	234.
NORM RESULTANT	0.09	1.95	0.04	78.	234.
SHOULDER LOADS (LB)					
TENSION	131.49	811.77	72.72	92.	266.
LEFT TENSION QRA	52.00	172.31	30.43	83.	173.
RIGHT TENSION QRA	40.98	138.31	31.66	84.	300.
LEG LOADS (LB)					
ANCHOR LOADS (LB)					
LEFT HORIZ X AXIS	50.43	589.15	36.23	84.	333.
LEFT HORIZ Y AXIS	5.57	66.06	1.11	86.	304.
LEFT HORIZ Z AXIS	-16.82	-14.48	-79.97	334.	87.
LEFT HORIZ RESULTANT	53.45	572.33	39.17	84.	402.
RIGHT HORIZ X AXIS	47.08	559.37	37.07	84.	393.
RIGHT HORIZ Y AXIS	5.10	83.74	1.54	83.	192.
RIGHT HORIZ Z AXIS	0.89	20.71	-4.99	82.	35.
RIGHT HORIZ RESULTANT	47.97	565.99	37.18	84.	395.
AT VERTICAL X AXIS	-16.26	24.44	-15.45	110.	0.
AT VERTICAL Y AXIS	7.94	22.00	6.95	85.	24.
AT VERTICAL Z AXIS	105.22	398.56	95.61	86.	23.
AT VERTICAL RESULTANT	106.76	398.67	96.25	86.	31.
SEAT LOADS (LB)					
LEFT LINK X AXIS	31.91	84.80	-148.71	159.	84.
RIGHT LINK X AXIS	-4.21	17.88	-157.27	191.	81.
X AXIS SUM	27.70	91.51	-302.81	176.	34.
X AXIS MINUS TARE	27.71	83.30	-153.42	186.	86.
CENTER LINK Y AXIS	-42.22	-8.04	-194.41	223.	77.
LEFT Z AXIS	30.12	656.08	0.51	91.	247.
RIGHT Z AXIS	36.51	486.48	31.99	100.	201.
CENTER Z AXIS	204.34	941.02	204.83	79.	0.
Z AXIS SUM	270.97	2028.58	271.33	91.	0.
Z AXIS MINUS TARE	270.88	1939.04	269.82	93.	0.
RESULTANT	275.84	2058.21	275.98	91.	0.
RESULTANT MINUS TARE	275.55	1950.98	274.65	91.	0.

CREST STUDY -GX TEST: 3144 SUBJ: M19 WT: 189.0 NOM G: 10.0 CELL: D

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK				-209.	
2.5V EXT PMA		2.50	-2.50	1.	106.
10V EXT PMA		10.01	-9.99	14.	23.
SLED ACCELERATION (G)					
X AXIS	-0.01	0.50	-9.92	159.	56.
Y AXIS	0.00	0.30	-0.38	259.	110.
Z AXIS	1.00	2.50	-0.68	56.	51.
SEAT ACCELERATION (G)					
X AXIS	0.48	2.28	-10.12	159.	50.
Y AXIS	0.00	1.27	-1.50	180.	172.
Z AXIS	0.87	8.19	-0.09	56.	191.
SLED VELOCITY (FT/S)	0.00	90.08	0.00	158.	0.
CHEST ACCELERATION (G)					
X AXIS EXTERNAL	0.30	2.11	-14.42	170.	88.
Y AXIS EXTERNAL	0.00	6.86	-3.45	93.	166.
Z AXIS EXTERNAL	0.87	10.30	-4.98	60.	165.
RESULTANT	1.01	16.37	0.49	89.	253.
NORM RESULTANT	0.10	1.65	0.05	89.	253.
HEAD ACCELERATION (G)					
X AXIS EXTERNAL	0.50	3.34	-10.31	284.	127.
Y AXIS EXTERNAL	0.02	0.74	-1.19	229.	138.
Z AXIS EXTERNAL	0.88	3.29	-15.90	150.	97.
RESULTANT	1.02	17.73	0.45	99.	206.
NORM RESULTANT	0.10	1.79	0.05	99.	206.
AT EXTERNAL	1.13	676.95	-243.35	150.	103.
THORAX ACCELERATION (G)					
X AXIS EXTERNAL	0.48	1.98	-13.51	215.	86.
Y AXIS EXTERNAL	0.00	1.73	-2.37	289.	65.
Z AXIS EXTERNAL	0.87	10.23	-3.04	46.	33.
RESULTANT	0.99	13.58	0.74	86.	246.
NORM RESULTANT	0.10	1.37	0.07	86.	246.
LUMBAR ACCELERATION (G)					
X AXIS EXTERNAL	0.48	2.48	-11.27	178.	77.
Y AXIS EXTERNAL	0.00	4.74	-4.02	59.	30.
Z AXIS EXTERNAL	0.88	11.12	-4.01	82.	33.
RESULTANT	1.01	15.35	0.71	83.	220.
NORM RESULTANT	0.10	1.55	0.07	83.	220.
SHOULDER LOADS (LBI)					
TENSION	62.89	877.22	16.03	92.	280.
LEFT TENSION QAA	25.14	183.18	23.89	76.	173.
RIGHT TENSION QAA	41.24	219.07	99.70	74.	272.
LEG LOADS (LBI)					
LEFT TENSION QAA	20.49	187.82	19.55	77.	12.
RIGHT TENSION QAA	14.43	125.99	13.48	77.	16.
ANCHOR LOADS (LBI)					
LEFT HORIZ X AXIS	46.25	709.18	38.23	84.	238.
LEFT HORIZ Y AXIS	9.30	68.33	-0.09	90.	269.
LEFT HORIZ Z AXIS	-13.71	-13.74	-83.54	4.	87.
LEFT HORIZ RESULTANT	48.38	717.00	38.71	84.	351.
RIGHT HORIZ X AXIS	37.69	631.68	35.64	85.	0.
RIGHT HORIZ Y AXIS	2.83	65.91	-0.87	81.	195.
RIGHT HORIZ Z AXIS	1.23	28.29	-3.52	82.	28.
RIGHT HORIZ RESULTANT	37.82	635.74	35.78	85.	0.
AT VERTICAL X AXIS	-10.89	10.50	-11.88	94.	0.
AT VERTICAL Y AXIS	4.28	21.36	3.08	78.	6.
AT VERTICAL Z AXIS	82.01	336.51	47.33	86.	30.
AT VERTICAL RESULTANT	83.11	337.27	47.54	86.	30.
SEAT LOADS (LBI)					
LEFT LINK X AXIS	17.87	86.18	-204.88	197.	83.
RIGHT LINK X AXIS	39.40	32.82	-41.82	0.	84.
X AXIS SUM	51.08	90.84	-245.53	197.	83.
X AXIS MINUS TARE	51.38	85.31	-95.12	37.	87.
CENTER LINK Y AXIS	-78.73	7.74	-230.53	225.	80.
LEFT Z AXIS	61.01	620.34	8.55	84.	221.
RIGHT Z AXIS	18.45	263.32	16.50	84.	0.
CENTER Z AXIS	204.60	986.61	207.22	81.	0.
Z AXIS SUM	282.05	1862.53	254.94	82.	235.
Z AXIS MINUS TARE	281.87	1874.88	261.80	84.	236.
RESULTANT	287.28	1880.85	259.02	82.	236.
RESULTANT MINUS TARE	297.23	1890.60	265.51	84.	236.

CREST STUDY -GX TEST: 3124 SUBJ: #16 MT: 196.0 NOM G: 10.0 CELL: 0

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK				-167.	
2.5V EXT PWA		2.50	-2.49	3.	50.
10V EXT PWA		10.01	-9.98	1.	50.
SLED ACCELERATION (G)					
X AXIS	-0.01	0.54	-9.89	159.	56.
Y AXIS	0.00	0.35	-0.31	265.	116.
Z AXIS	1.00	2.61	-0.73	55.	50.
SEAT ACCELERATION (G)					
X AXIS	0.49	2.45	-10.14	160.	49.
Y AXIS	0.00	1.34	-1.54	181.	174.
Z AXIS	0.37	8.33	-0.55	55.	167.
SLED VELOCITY (FT/S)	0.00	90.23	0.00	157.	0.
CHEST ACCELERATION (G)					
X AXIS EXTERNAL	0.49	7.90	-11.03	114.	92.
Y AXIS EXTERNAL	-0.01	9.20	-4.94	105.	122.
Z AXIS EXTERNAL	0.87	17.70	-4.37	103.	183.
RESULTANT	1.00	19.47	-0.51	103.	209.
NORM RESULTANT	0.10	1.97	0.05	103.	209.
HEAD ACCELERATION (G)					
X AXIS EXTERNAL	0.51	2.97	-10.60	271.	122.
Y AXIS EXTERNAL	0.02	0.97	-0.78	93.	252.
Z AXIS EXTERNAL	0.91	4.58	-18.71	139.	86.
RESULTANT	1.04	20.95	-0.84	86.	202.
NORM RESULTANT	0.11	2.12	-0.08	86.	202.
AT EXTERNAL	1.19	856.94	-526.48	139.	84.
THORAX ACCELERATION (G)					
X AXIS EXTERNAL	0.49	1.88	-13.08	185.	85.
Y AXIS EXTERNAL	0.00	1.63	-3.04	102.	60.
Z AXIS EXTERNAL	0.87	8.55	-4.51	61.	104.
RESULTANT	1.00	14.01	-0.71	85.	314.
NORM RESULTANT	0.10	1.42	-0.07	85.	314.
LUMBAR ACCELERATION (G)					
X AXIS EXTERNAL	0.49	10.68	-14.22	169.	85.
Y AXIS EXTERNAL	0.01	6.49	-1.92	68.	215.
Z AXIS EXTERNAL	0.87	14.93	-0.60	70.	159.
RESULTANT	1.00	18.99	-0.49	70.	225.
NORM RESULTANT	0.10	1.92	-0.05	70.	225.
SHOULDER LOADS (LB)					
TENSION	85.53	890.12	-50.36	91.	235.
LEFT TENSION GAA	33.82	172.40	-23.45	82.	222.
RIGHT TENSION GAA	38.10	305.94	-36.89	80.	2.
LEG LOADS (LB)					
LEFT TENSION GAA	26.68	244.28	-26.43	76.	0.
RIGHT TENSION GAA	20.82	178.07	-20.92	78.	1.
ANCHOR LOADS (LB)					
LEFT HORIZ X AXIS	57.80	889.48	-52.18	79.	338.
LEFT HORIZ Y AXIS	1.27	45.25	-0.02	78.	185.
LEFT HORIZ Z AXIS	-15.13	-14.08	-68.48	392.	78.
LEFT HORIZ RESULTANT	58.78	708.04	-54.40	79.	338.
RIGHT HORIZ X AXIS	48.47	877.84	-40.84	80.	335.
RIGHT HORIZ Y AXIS	3.32	59.98	-2.95	74.	20.
RIGHT HORIZ Z AXIS	1.43	28.71	-3.33	74.	34.
RIGHT HORIZ RESULTANT	48.81	880.57	-40.88	80.	335.
AT VERTICAL X AXIS	-7.02	20.81	-6.89	108.	0.
AT VERTICAL Y AXIS	2.85	7.08	-0.45	53.	174.
AT VERTICAL Z AXIS	82.84	328.57	-55.15	84.	21.
AT VERTICAL RESULTANT	83.29	328.11	-55.24	84.	21.
SEAT LOADS (LB)					
LEFT LINK X AXIS	18.81	28.47	-189.78	197.	78.
RIGHT LINK X AXIS	30.28	50.20	-61.80	197.	79.
X AXIS SUM	48.89	78.67	-270.22	197.	78.
X AXIS MINUS TARE	48.01	83.28	-108.73	48.	75.
CENTER LINK Y AXIS	58.80	58.70	-101.03	0.	78.
LEFT Z AXIS	58.80	811.88	-28.88	79.	214.
RIGHT Z AXIS	42.18	488.82	-8.75	78.	226.
CENTER Z AXIS	175.13	1053.73	-175.38	78.	1.
Z AXIS SUM	275.81	2139.42	-253.87	79.	228.
Z AXIS MINUS TARE	275.88	2052.85	-253.85	79.	228.
RESULTANT	285.83	2174.81	-264.88	79.	228.
RESULTANT MINUS TARE	285.80	2057.77	-272.09	79.	228.

CREST STUDY -GX TEST: 9123 SUBJ: M-2 WT: 185.0 MON G: 10.0 CELL: D

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK					
2.5V EXT PWA		2.50	2.50	-160.	
10V EXT PWA		10.01	-9.99	2.	1.
SLED ACCELERATION (G)				1.	0.
X AXIS	-0.01	0.50	-9.93	159.	56.
Y AXIS	0.00	0.42	-0.33	170.	125.
Z AXIS	1.00	2.56	-0.71	56.	51.
SEAT ACCELERATION (G)					
X AXIS	0.50	2.62	-10.13	160.	50.
Y AXIS	0.00	1.29	-1.47	226.	173.
Z AXIS	0.87	8.14	-0.51	56.	202.
SLED VELOCITY (FT/S)	0.00	30.01	0.00	161.	0.
CHEST ACCELERATION (G)					
X AXIS EXTERNAL	0.42	1.47	-14.52	219.	93.
Y AXIS EXTERNAL	0.00	2.79	-1.38	80.	167.
Z AXIS EXTERNAL	0.87	8.22	-1.31	113.	170.
RESULTANT	0.97	16.34	0.79	93.	235.
NORM RESULTANT	0.10	1.85	0.08	93.	235.
HEAD ACCELERATION (G)					
X AXIS EXTERNAL	0.52	2.71	-8.47	230.	106.
Y AXIS EXTERNAL	-0.07	0.37	-0.72	193.	158.
Z AXIS EXTERNAL	0.75	9.29	-13.23	177.	95.
RESULTANT	0.92	15.28	0.72	100.	6.
NORM RESULTANT	0.09	1.54	0.07	100.	6.
AT EXTERNAL	-0.78	840.21	-170.37	135.	66.
THORAX ACCELERATION (G)					
X AXIS EXTERNAL	0.48	2.15	-14.08	189.	92.
Y AXIS EXTERNAL	0.00	1.93	-1.74	189.	286.
Z AXIS EXTERNAL	0.87	8.83	-1.17	52.	69.
RESULTANT	1.00	18.17	0.69	92.	242.
NORM RESULTANT	0.10	1.43	0.07	92.	242.
LUMBAR ACCELERATION (G)					
X AXIS EXTERNAL	0.48	2.83	-12.72	182.	75.
Y AXIS EXTERNAL	-0.01	0.75	-4.74	185.	67.
Z AXIS EXTERNAL	0.88	15.78	-3.13	69.	189.
RESULTANT	1.00	18.15	0.59	70.	37.
NORM RESULTANT	0.10	1.83	0.06	70.	37.
SHOULDER LOADS (LB)					
TENSION	148.12	784.38	40.98	93.	201.
LEFT TENSION QAA	25.38	148.39	18.38	77.	189.
RIGHT TENSION QAA	36.33	152.41	21.52	84.	165.
LEG LOADS (LB)					
LEFT TENSION QAA	18.88	180.27	12.10	83.	170.
RIGHT TENSION QAA	18.84	188.02	18.98	79.	1.
ANCHOR LOADS (LB)					
LEFT HORIZ X AXIS	41.88	821.05	-28.08	88.	435.
LEFT HORIZ Y AXIS	2.87	84.39	-0.58	87.	199.
LEFT HORIZ Z AXIS	-13.17	-10.98	-78.78	279.	88.
LEFT HORIZ RESULTANT	84.81	832.17	30.13	88.	439.
RIGHT HORIZ X AXIS	44.10	815.82	23.88	88.	417.
RIGHT HORIZ Y AXIS	3.78	73.31	-1.18	90.	196.
RIGHT HORIZ Z AXIS	0.88	28.89	-4.38	83.	34.
RIGHT HORIZ RESULTANT	88.27	830.24	23.89	88.	435.
AT VERTICAL X AXIS	-20.18	4.58	-19.99	121.	0.
AT VERTICAL Y AXIS	4.14	18.28	2.13	84.	34.
AT VERTICAL Z AXIS	80.47	858.10	78.75	91.	25.
AT VERTICAL RESULTANT	88.18	888.42	80.55	91.	34.
SEAT LOADS (LB)					
LEFT LINK X AXIS	10.83	40.77	-178.70	433.	91.
RIGHT LINK X AXIS	31.83	88.38	-123.72	434.	89.
X AXIS SUM	42.66	129.15	-203.42	433.	91.
X AXIS MINUS TARE	42.64	142.38	-181.01	433.	89.
CENTER LINK Y AXIS	38.15	40.54	-88.42	226.	95.
LEFT Z AXIS	82.48	84.87	11.83	92.	235.
RIGHT Z AXIS	88.68	843.28	2.78	91.	422.
CENTER Z AXIS	818.33	843.00	222.37	88.	1.
Z AXIS SUM	818.48	8138.01	279.80	82.	238.
Z AXIS MINUS TARE	810.48	8088.51	289.83	93.	238.
RESULTANT	816.17	3181.07	278.14	82.	238.
RESULTANT MINUS TARE	816.38	2088.11	288.12	93.	238.

CREST STUDY -GX TEST: 3114 SUBJ: T-4 WT: 181.0 NOM G: 10.0 CELL: D

DATA ID	IMMEDIATE PHEIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK					
2.5V EXT PMA		2.50	2.49	95.	87.
10V EXT PMA		10.02	9.99	95.	47.
SLED ACCELERATION (G)					
X AXIS	-0.01	0.49	-9.98	158.	57.
Y AXIS	0.00	0.37	-0.39	238.	303.
Z AXIS	1.00	2.42	-0.67	57.	52.
SEAT ACCELERATION (G)					
X AXIS	0.49	2.78	-10.15	160.	51.
Y AXIS	0.00	1.49	-1.09	244.	255.
Z AXIS	0.97	8.09	-0.53	57.	166.
SLED VELOCITY (FT/S)	0.00	30.35	0.00	158.	0.
CHEST ACCELERATION (G)					
X AXIS EXTERNAL	0.50	2.82	-14.74	202.	104.
Y AXIS EXTERNAL	0.00	5.43	-0.94	104.	213.
Z AXIS EXTERNAL	0.87	9.13	-1.49	104.	206.
RESULTANT	1.00	18.17	-0.98	104.	261.
NORM RESULTANT	0.10	1.82	0.10	104.	261.
HEAD ACCELERATION (G)					
X AXIS EXTERNAL	0.48	2.40	-10.13	197.	99.
Y AXIS EXTERNAL	0.04	0.95	-0.82	109.	149.
Z AXIS EXTERNAL	0.85	4.02	-16.41	183.	88.
RESULTANT	0.98	18.80	-0.50	88.	21.
NORM RESULTANT	0.10	1.89	-0.05	88.	21.
AT EXTERNAL	-1.11	806.58	-269.18	122.	242.
THORAX ACCELERATION (G)					
X AXIS EXTERNAL	0.48	3.81	-15.01	184.	88.
Y AXIS EXTERNAL	-0.01	1.83	-1.81	210.	94.
Z AXIS EXTERNAL	0.87	6.04	-1.06	49.	33.
RESULTANT	1.00	15.13	-0.87	88.	279.
NORM RESULTANT	0.10	1.52	-0.09	88.	279.
LUMBAR ACCELERATION (G)					
X AXIS EXTERNAL	0.48	2.88	-15.55	185.	88.
Y AXIS EXTERNAL	0.00	3.43	-1.53	74.	26.
Z AXIS EXTERNAL	0.87	12.27	-1.27	71.	182.
RESULTANT	1.00	18.57	-0.57	88.	245.
NORM RESULTANT	0.10	1.86	0.04	88.	243.
SHOULDER LOADS (LBS)					
TENSION	88.93	858.13	22.92	89.	195.
LEFT TENSION GAA	28.82	188.85	19.91	78.	178.
RIGHT TENSION GAA	28.53	208.69	24.48	78.	14.
LEG LOADS (LBS)					
LEFT TENSION GAA	19.80	287.39	12.78	77.	13.
RIGHT TENSION GAA	17.20	190.98	15.87	79.	7.
ANCHOR LOADS (LBS)					
LEFT HORIZ X AXIS	25.62	683.77	-24.83	86.	0.
LEFT HORIZ Y AXIS	2.12	88.38	-0.07	87.	269.
LEFT HORIZ Z AXIS	-11.44	-11.21	-90.50	0.	83.
LEFT HORIZ RESULTANT	28.14	882.85	27.16	86.	0.
RIGHT HORIZ X AXIS	26.03	880.79	23.08	86.	445.
RIGHT HORIZ Y AXIS	0.94	78.52	-0.54	85.	194.
RIGHT HORIZ Z AXIS	0.28	31.06	-5.65	83.	41.
RIGHT HORIZ RESULTANT	25.08	895.88	23.08	86.	445.
AT VERTICAL X AXIS	-7.31	27.59	-8.78	95.	0.
AT VERTICAL Y AXIS	9.87	8.58	1.05	61.	255.
AT VERTICAL Z AXIS	51.45	448.51	38.38	88.	24.
AT VERTICAL RESULTANT	52.12	650.04	38.49	88.	24.
SEAT LOADS (LBS)					
LEFT LINK X AXIS	28.47	48.83	-187.50	332.	84.
RIGHT LINK X AXIS	15.35	91.00	-129.95	323.	82.
X AXIS SUM	43.81	78.50	-317.45	332.	84.
X AXIS MINUS TARE	43.85	95.33	-175.71	50.	88.
CENTER LINK Y AXIS	-52.83	-14.86	-227.59	448.	89.
LEFT Z AXIS	28.47	686.09	25.39	90.	4.
RIGHT Z AXIS	15.35	649.81	20.18	89.	319.
CENTER Z AXIS	181.82	989.21	160.52	90.	2.
Z AXIS SUM	229.69	2241.81	223.10	90.	2.
Z AXIS MINUS TARE	229.37	2148.22	220.80	90.	2.
RESULTANT	239.77	2279.78	233.02	90.	2.
RESULTANT MINUS TARE	239.65	2167.34	231.67	90.	2.



CREST STUDY -GX TEST: 3112 SUBJ: M21 WT: 128.0 MON G: 10.0 CELL: D

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK				-147.	
2.5V EXT PWA		2.50	2.50	82.	238.
10V EXT PWA		10.01	-9.99	17.	36.
SLED ACCELERATION (G)					
X AXIS	-0.02	0.44	-9.94	157.	57.
Y AXIS	0.00	0.17	-0.21	358.	81.
Z AXIS	1.00	2.43	-0.73	56.	52.
SEAT ACCELERATION (G)					
X AXIS	0.48	3.04	-10.17	158.	50.
Y AXIS	0.00	1.08	-1.34	180.	171.
Z AXIS	0.87	6.44	-0.80	57.	164.
SLED VELOCITY (FT/S)	0.00	30.54	0.00	156.	0.
CHEST ACCELERATION (G)					
X AXIS EXTERNAL	0.48	2.32	-11.32	187.	87.
Y AXIS EXTERNAL	0.00	4.39	-2.05	119.	126.
Z AXIS EXTERNAL	0.86	8.73	-0.74	89.	163.
RESULTANT	0.98	14.98	-0.32	88.	159.
NORM RESULTANT	0.10	1.51	-0.03	88.	159.
HEAD ACCELERATION (G)					
X AXIS EXTERNAL	0.51	1.99	-9.92	198.	79.
Y AXIS EXTERNAL	0.04	0.66	-1.65	123.	81.
Z AXIS EXTERNAL	0.88	9.47	-18.88	132.	79.
RESULTANT	1.01	21.38	-0.95	79.	3.
NORM RESULTANT	0.10	2.15	-0.10	79.	3.
AT EXTERNAL	-0.52	509.86	-562.21	130.	79.
THORAX ACCELERATION (G)					
X AXIS EXTERNAL	0.48	2.41	-13.22	182.	86.
Y AXIS EXTERNAL	-0.01	1.45	-2.90	222.	109.
Z AXIS EXTERNAL	0.87	4.72	-3.85	47.	88.
RESULTANT	1.00	13.73	-0.51	86.	226.
NORM RESULTANT	0.10	1.38	-0.05	86.	226.
LUMBAR ACCELERATION (G)					
X AXIS EXTERNAL	0.50	4.14	-10.98	160.	78.
Y AXIS EXTERNAL	0.00	10.51	-1.77	64.	92.
Z AXIS EXTERNAL	0.87	19.09	-1.51	64.	33.
RESULTANT	1.00	22.78	-0.32	64.	189.
NORM RESULTANT	0.10	2.29	-0.03	64.	189.
SHOULDER LOADS (LB)					
TENSION	74.98	873.48	68.08	84.	199.
LEFT TENSION GAA	25.88	89.08	18.88	74.	260.
RIGHT TENSION GAA	31.48	145.48	26.71	76.	164.
LEG LOADS (LB)					
LEFT TENSION GAA	18.51	135.08	17.85	75.	7.
RIGHT TENSION GAA	15.92	83.43	14.73	75.	1.
ANCHOR LOADS (LB)					
LEFT HORIZ X AXIS	51.83	405.88	42.75	72.	447.
LEFT HORIZ Y AXIS	7.28	82.91	-2.60	74.	183.
LEFT HORIZ Z AXIS	-17.28	-17.14	-79.19	0.	78.
LEFT HORIZ RESULTANT	55.21	418.06	46.32	74.	447.
RIGHT HORIZ X AXIS	37.81	338.98	31.75	76.	327.
RIGHT HORIZ Y AXIS	5.39	57.41	2.18	76.	216.
RIGHT HORIZ Z AXIS	-0.53	0.98	-12.48	162.	94.
RIGHT HORIZ RESULTANT	38.21	343.87	31.94	76.	327.
AT VERTICAL X AXIS	-0.20	-2.08	-33.11	49.	86.
AT VERTICAL Y AXIS	11.15	39.88	0.74	9.	20.
AT VERTICAL Z AXIS	82.01	288.68	52.25	85.	19.
AT VERTICAL RESULTANT	83.68	271.53	53.53	85.	19.
SEAT LOADS (LB)					
LEFT LINK X AXIS	24.82	24.38	-169.58	0.	89.
RIGHT LINK X AXIS	3.81	8.51	-118.29	333.	77.
X AXIS SUM	28.73	27.37	-271.37	0.	89.
X AXIS MINUS TARE	28.91	88.19	-118.83	28.	76.
CENTER LINK Y AXIS	-25.18	-9.12	-152.08	203.	68.
LEFT Z AXIS	33.18	382.47	11.87	70.	191.
RIGHT Z AXIS	30.13	297.08	7.52	79.	313.
CENTER Z AXIS	123.84	689.84	123.84	73.	0.
Z AXIS SUM	187.18	1318.22	188.25	75.	0.
Z AXIS MINUS TARE	187.08	1228.81	188.18	75.	3.
RESULTANT	191.04	1362.67	191.88	75.	0.
RESULTANT MINUS TARE	190.87	1242.54	190.83	75.	1.

CREST STUDY -GX TEST: 3111 SUBJ: M20 WT: 192.0 NOM G: 10.0 CELL: 0

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK					
2.5V EXT PMA		2.50	2.50	-139.	0.
10V EXT PMA		10.01	-9.99	1.	9.
SLED ACCELERATION (G)					
X AXIS	-0.02	0.54	-10.00	157.	55.
Y AXIS	0.00	0.34	-0.35	243.	313.
Z AXIS	1.00	2.51	-0.66	54.	50.
SEAT ACCELERATION (G)					
X AXIS	0.40	2.93	-10.16	158.	48.
Y AXIS	0.00	1.22	-0.99	224.	217.
Z AXIS	0.87	8.05	-0.62	55.	164.
SLED VELOCITY (FT/S)	0.00	30.48	-0.00	157.	0.
CHEST ACCELERATION (G)					
X AXIS EXTERNAL	0.50	2.01	-17.51	185.	87.
Y AXIS EXTERNAL	0.00	6.32	-3.09	90.	149.
Z AXIS EXTERNAL	0.87	11.43	-4.44	97.	159.
RESULTANT	1.00	20.20	-0.37	98.	169.
NORM RESULTANT	0.10	2.02	-0.04	98.	169.
HEAD ACCELERATION (G)					
X AXIS EXTERNAL	0.41	2.97	-12.45	233.	102.
Y AXIS EXTERNAL	0.01	1.30	-0.94	125.	174.
Z AXIS EXTERNAL	0.90	9.72	-19.15	129.	93.
RESULTANT	1.03	22.15	-0.79	96.	28.
NORM RESULTANT	0.10	2.21	-0.08	96.	28.
AT EXTERNAL	3.01	688.92	-311.01	126.	212.
THORAX ACCELERATION (G)					
X AXIS EXTERNAL	0.40	2.14	-14.14	168.	83.
Y AXIS EXTERNAL	0.00	1.70	-4.05	50.	59.
Z AXIS EXTERNAL	0.88	10.30	-4.63	51.	93.
RESULTANT	1.01	14.71	-0.74	93.	311.
NORM RESULTANT	0.10	1.47	-0.07	93.	311.
LUMBAR ACCELERATION (G)					
X AXIS EXTERNAL	0.40	6.98	-12.55	167.	74.
Y AXIS EXTERNAL	0.00	8.89	-2.55	58.	165.
Z AXIS EXTERNAL	0.87	19.88	-4.21	59.	165.
RESULTANT	1.00	17.20	-0.22	59.	186.
NORM RESULTANT	0.10	1.72	-0.02	59.	186.
SHOULDER LOADS (LB)					
TENSION	80.53	1021.08	44.03	89.	208.
LEFT TENSION QAA	34.43	187.01	20.43	75.	415.
RIGHT TENSION QAA	39.78	244.42	38.39	77.	3.
LEG LOADS (LB)					
LEFT TENSION QAA	26.70	239.73	26.32	81.	0.
RIGHT TENSION QAA	10.98	138.32	8.08	85.	165.
ANCHOR LOADS (LB)					
LEFT HORIZ X AXIS	55.50	710.84	51.70	82.	194.
LEFT HORIZ Y AXIS	1.82	52.82	-1.89	83.	185.
LEFT HORIZ Z AXIS	-13.04	-11.10	-78.89	442.	84.
LEFT HORIZ RESULTANT	57.05	717.15	54.04	84.	196.
RIGHT HORIZ X AXIS	38.85	629.63	35.64	85.	194.
RIGHT HORIZ Y AXIS	2.74	62.91	-2.59	83.	194.
RIGHT HORIZ Z AXIS	1.78	28.11	-4.48	82.	159.
RIGHT HORIZ RESULTANT	38.09	633.00	35.67	85.	196.
AT VERTICAL X AXIS	-7.45	46.07	-7.11	94.	0.
AT VERTICAL Y AXIS	1.22	9.87	-2.58	165.	55.
AT VERTICAL Z AXIS	68.42	467.84	56.89	87.	20.
AT VERTICAL RESULTANT	68.84	469.78	56.78	87.	20.
SEAT LOADS (LB)					
LEFT LINK X AXIS	18.74	62.38	-200.25	178.	80.
RIGHT LINK X AXIS	15.01	88.93	-99.02	422.	80.
X AXIS SUM	31.75	128.90	-209.27	422.	80.
X AXIS MINUS TARE	32.00	125.15	-148.62	423.	86.
CENTER LINK Y AXIS	-28.18	5.12	-186.28	201.	77.
LEFT Z AXIS	88.28	753.13	47.78	79.	191.
RIGHT Z AXIS	45.88	555.25	-2.14	81.	304.
CENTER Z AXIS	167.34	1064.88	187.94	79.	1.
Z AXIS SUM	282.57	2388.60	284.83	79.	1.
Z AXIS MINUS TARE	282.41	2278.05	282.26	80.	1.
RESULTANT	286.84	2385.18	288.04	79.	1.
RESULTANT MINUS TARE	285.71	2281.35	288.08	80.	1.

CAEST STUDY -GX TEST: 3110 SUBJ: L-3 WT: 184.0 NOM G: 10.0 CELL: D

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MAR					
2.5V EXT PWA		2.50	2.50	-137.	
10V EXT PWA		10.01	-9.99	8.	4.
SLED ACCELERATION (G)				5.	103.
X AXIS	-0.02	0.55	-9.92	157.	55.
Y AXIS	0.00	0.42	-0.29	170.	125.
Z AXIS	1.00	2.51	-0.72	54.	50.
SEAT ACCELERATION (G)					
X AXIS	0.49	2.70	-10.12	160.	48.
Y AXIS	0.00	1.22	-1.24	226.	173.
Z AXIS	0.87	7.99	-0.87	55.	166.
SLED VELOCITY (FT/S)	0.00	90.32	-0.00	155.	0.
CHEST ACCELERATION (G)					
X AXIS EXTERNAL	0.50	7.85	-10.84	197.	87.
Y AXIS EXTERNAL	0.02	4.77	-2.33	119.	210.
Z AXIS EXTERNAL	0.87	12.07	-8.08	116.	191.
RESULTANT	1.00	19.32	-0.71	86.	316.
NORM RESULTANT	0.10	1.34	-0.07	86.	316.
HEAD ACCELERATION (G)					
X AXIS EXTERNAL	0.48	2.33	-10.32	343.	120.
Y AXIS EXTERNAL	0.01	1.27	-1.21	93.	194.
Z AXIS EXTERNAL	0.78	5.02	-12.38	178.	89.
RESULTANT	0.91	15.01	-0.19	89.	207.
NORM RESULTANT	0.09	1.51	-0.02	89.	207.
AT EXTERNAL	-0.04	587.45	-321.04	144.	80.
THORAX ACCELERATION (G)					
X AXIS EXTERNAL	0.48	2.34	-11.05	183.	82.
Y AXIS EXTERNAL	0.01	5.83	-2.58	52.	40.
Z AXIS EXTERNAL	0.88	9.24	-3.49	51.	37.
RESULTANT	1.00	12.86	-0.51	51.	158.
NORM RESULTANT	0.10	1.28	-0.05	51.	158.
LUMBAR ACCELERATION (G)					
X AXIS EXTERNAL	0.48	2.68	-10.48	183.	83.
Y AXIS EXTERNAL	-0.01	2.58	-1.94	72.	64.
Z AXIS EXTERNAL	0.88	28.64	-7.01	72.	171.
RESULTANT	1.00	29.73	-0.20	73.	248.
NORM RESULTANT	0.10	3.00	-0.02	73.	248.
SHOULDER LOADS (LB)					
TENSION	108.88	758.41	53.80	91.	234.
LEFT TENSION QAA	48.88	178.73	23.89	82.	184.
RIGHT TENSION QAA	59.84	188.13	33.30	78.	178.
LEG LOADS (LB)					
LEFT TENSION QAA	28.48	188.95	18.86	77.	177.
RIGHT TENSION QAA	18.88	141.08	13.13	77.	175.
ANCHOR LOADS (LB)					
LEFT HORIZ X AXIS	81.10	814.73	48.38	83.	197.
LEFT HORIZ Y AXIS	5.10	72.32	1.58	85.	186.
LEFT HORIZ Z AXIS	-18.18	-15.28	-93.42	202.	87.
LEFT HORIZ RESULTANT	89.95	825.55	49.23	83.	200.
RIGHT HORIZ X AXIS	51.58	585.31	40.47	81.	419.
RIGHT HORIZ Y AXIS	8.11	78.70	-2.21	80.	196.
RIGHT HORIZ Z AXIS	1.43	22.81	-3.08	81.	28.
RIGHT HORIZ RESULTANT	51.87	590.58	40.78	81.	457.
AT VERTICAL X AXIS	-14.73	8.75	-14.52	103.	0.
AT VERTICAL Y AXIS	4.30	12.24	-2.56	70.	27.
AT VERTICAL Z AXIS	78.82	383.13	70.35	84.	21.
AT VERTICAL RESULTANT	80.90	383.27	71.18	84.	21.
SEAT LOADS (LB)					
LEFT LINK X AXIS	9.11	30.17	-178.25	179.	79.
RIGHT LINK X AXIS	91.48	57.03	-114.41	448.	81.
X AXIS SUM	34.57	77.60	-291.50	467.	80.
X AXIS MINUS TARE	34.73	82.38	-136.43	48.	85.
CENTER LINK Y AXIS	87.12	71.33	-39.99	204.	77.
LEFT Z AXIS	64.22	126.74	5.86	77.	283.
RIGHT Z AXIS	41.71	818.38	28.55	80.	421.
CENTER Z AXIS	177.18	812.89	162.78	119.	0.
Z AXIS SUM	273.12	1938.88	282.29	79.	0.
Z AXIS MINUS TARE	273.04	1841.58	279.81	79.	1.
RESULTANT	288.97	1840.85	281.80	79.	1.
RESULTANT MINUS TARE	289.31	1848.12	288.85	79.	1.

CREST STUDY -GX TEST: 3109 SUBJ: K-3 WT: 138.0 NOM G: 10.0 CELL: D

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK				-137.	
2.5V EXT PWR		2.50	2.50	9.	144.
10V EXT PWR		10.01	9.99	65.	12.
SLED ACCELERATION (G)					
X AXIS	-0.01	0.54	-9.98	175.	57.
Y AXIS	0.00	0.32	-0.22	174.	62.
Z AXIS	1.00	2.38	-0.67	56.	52.
SEAT ACCELERATION (G)					
X AXIS	0.48	2.47	-10.21	156.	50.
Y AXIS	0.00	1.13	-1.07	223.	169.
Z AXIS	0.87	8.03	-0.12	57.	161.
SLED VELOCITY (FT/S)	0.00	30.60	0.00	159.	0.
CHEST ACCELERATION (G)					
X AXIS EXTERNAL	0.48	2.31	-12.55	178.	87.
Y AXIS EXTERNAL	0.00	9.97	-0.90	95.	151.
Z AXIS EXTERNAL	0.87	10.52	-1.03	87.	201.
RESULTANT	1.00	15.42	0.21	88.	227.
NORM RESULTANT	0.10	1.55	0.02	88.	227.
HEAD ACCELERATION (G)					
X AXIS EXTERNAL	0.53	2.57	-6.24	280.	120.
Y AXIS EXTERNAL	0.06	1.74	-0.32	119.	174.
Z AXIS EXTERNAL	0.90	2.71	-16.51	192.	79.
RESULTANT	1.04	17.84	0.89	79.	11.
NORM RESULTANT	0.10	1.77	0.10	79.	11.
AT EXTERNAL	2.28	537.19	-368.35	120.	70.
THORAX ACCELERATION (G)					
X AXIS EXTERNAL	0.48	2.78	-14.45	194.	86.
Y AXIS EXTERNAL	0.00	1.33	-2.08	355.	90.
Z AXIS EXTERNAL	0.87	4.43	-0.64	40.	89.
RESULTANT	1.00	14.54	0.89	86.	339.
NORM RESULTANT	0.10	1.46	0.07	86.	339.
LUMBAR ACCELERATION (G)					
X AXIS EXTERNAL	0.43	2.35	-13.65	163.	76.
Y AXIS EXTERNAL	0.00	9.37	-2.00	68.	211.
Z AXIS EXTERNAL	0.87	8.50	-0.86	78.	32.
RESULTANT	0.99	18.21	0.59	77.	219.
NORM RESULTANT	0.10	1.62	0.06	77.	219.
SHOULDER LOADS (LB)					
TENSION	60.58	691.33	11.78	87.	279.
LEFT TENSION QAA	24.81	147.48	15.08	77.	173.
RIGHT TENSION QAA	28.82	157.79	24.48	78.	2.
LEG LOADS (LB)					
LEFT TENSION QAA	12.88	158.90	11.23	78.	181.
RIGHT TENSION QAA	10.88	107.87	9.57	78.	1.
ANCHOR LOADS (LB)					
LEFT HORIZ X AXIS	32.55	540.49	23.44	83.	333.
LEFT HORIZ Y AXIS	4.34	71.65	0.90	86.	204.
LEFT HORIZ Z AXIS	-14.30	-12.23	-66.92	337.	83.
LEFT HORIZ RESULTANT	35.83	551.98	27.07	83.	333.
RIGHT HORIZ X AXIS	28.82	649.48	21.18	83.	464.
RIGHT HORIZ Y AXIS	9.24	78.86	-1.05	83.	192.
RIGHT HORIZ Z AXIS	0.89	12.24	-7.34	78.	46.
RIGHT HORIZ RESULTANT	28.03	648.43	21.23	83.	464.
AT VERTICAL X AXIS	-10.59	-2.79	-36.04	36.	75.
AT VERTICAL Y AXIS	6.18	45.31	5.44	83.	1.
AT VERTICAL Z AXIS	36.73	346.11	29.39	86.	24.
AT VERTICAL RESULTANT	38.73	350.83	30.31	86.	24.
SEAT LOADS (LB)					
LEFT LINK X AXIS	14.29	33.68	-186.78	343.	85.
RIGHT LINK X AXIS	33.08	42.48	-87.48	466.	83.
X AXIS SUM	47.33	73.75	-284.26	466.	85.
X AXIS MINUS TARE	47.84	87.53	-129.88	38.	87.
CENTER LINK Y AXIS	52.31	58.13	-65.94	223.	89.
LEFT Z AXIS	38.00	478.27	4.46	84.	368.
RIGHT Z AXIS	18.29	382.68	4.88	83.	329.
CENTER Z AXIS	134.82	758.81	125.16	92.	0.
Z AXIS SUM	192.21	1595.38	175.91	83.	224.
Z AXIS MINUS TARE	192.18	1508.80	179.38	85.	224.
RESULTANT	204.76	1621.66	184.27	83.	234.
RESULTANT MINUS TARE	204.70	1516.28	188.42	85.	224.

CREST STUDY -GX TEST: 3108 SUBJ: 8-1 WT: 166.0 NCM G: 10.0 CELL: D

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK					
2.5V EXT PWR		2.50	2.50	-130.	142.
10V EXT PWR		10.01	9.99	322.	4.
SLED ACCELERATION (G)					
X AXIS	-0.02	0.50	-9.95	157.	55.
Y AXIS	0.00	0.22	-0.22	324.	58.
Z AXIS	1.00	2.58	-0.71	55.	50.
SEAT ACCELERATION (G)					
X AXIS	0.48	2.98	-10.15	158.	49.
Y AXIS	0.00	1.18	-1.34	225.	172.
Z AXIS	0.87	8.13	-0.58	55.	164.
SLED VELOCITY (FT/S)	0.00	30.82	0.00	161.	0.
CHEST ACCELERATION (G)					
X AXIS EXTERNAL	0.44	3.43	-11.92	185.	70.
Y AXIS EXTERNAL	-0.05	6.73	-1.77	72.	180.
Z AXIS EXTERNAL	0.88	10.16	-1.58	86.	172.
RESULTANT	0.97	14.55	-2.27	86.	208.
NORM RESULTANT	0.10	1.48	0.03	86.	208.
HEAD ACCELERATION (G)					
X AXIS EXTERNAL	0.65	2.05	-7.60	195.	100.
Y AXIS EXTERNAL	0.03	0.42	-0.91	232.	192.
Z AXIS EXTERNAL	0.91	3.55	-0.87	178.	76.
RESULTANT	1.12	11.25	-0.54	91.	18.
NORM RESULTANT	0.11	1.13	-0.05	91.	18.
RY EXTERNAL	-4.01	301.40	-229.64	119.	218.
THORAX ACCELERATION (G)					
X AXIS EXTERNAL	0.48	3.79	-11.34	163.	85.
Y AXIS EXTERNAL	0.00	1.61	-1.73	207.	62.
Z AXIS EXTERNAL	0.87	16.51	-0.17	53.	40.
RESULTANT	1.00	16.41	-0.66	53.	223.
NORM RESULTANT	0.10	1.65	-0.07	53.	223.
LUMBAR ACCELERATION (G)					
X AXIS EXTERNAL	0.48	10.98	-12.41	171.	76.
Y AXIS EXTERNAL	0.00	4.08	-3.74	66.	77.
Z AXIS EXTERNAL	0.87	18.77	-9.15	67.	164.
RESULTANT	1.00	20.54	-0.50	67.	222.
NORM RESULTANT	0.10	2.08	-0.05	67.	222.
SHOULDER LOADS (LB)					
TENSION	159.86	683.00	59.81	90.	181.
LEFT TENSION QAA	53.28	153.78	20.99	88.	178.
RIGHT TENSION QAA	36.65	146.93	16.05	85.	179.
LEG LOADS (LB)					
LEFT TENSION QAA	10.78	119.33	7.65	86.	172.
RIGHT TENSION QAA	17.01	84.18	7.72	87.	165.
ANCHOR LOADS (LB)					
LEFT HORIZ X AXIS	87.63	478.84	-20.80	85.	469.
LEFT HORIZ Y AXIS	0.33	36.21	-4.88	86.	186.
LEFT HORIZ Z AXIS	-21.57	-18.27	-73.72	394.	89.
LEFT HORIZ RESULTANT	71.48	485.30	28.08	86.	469.
RIGHT HORIZ X AXIS	81.81	474.33	38.01	86.	181.
RIGHT HORIZ Y AXIS	0.16	81.39	1.03	85.	173.
RIGHT HORIZ Z AXIS	1.12	15.81	-5.18	84.	54.
RIGHT HORIZ RESULTANT	81.93	478.54	38.03	86.	448.
RT VERTICAL X AXIS	-18.58	2.33	-18.83	453.	74.
RT VERTICAL Y AXIS	12.38	34.14	10.48	87.	26.
RT VERTICAL Z AXIS	125.48	330.37	102.18	86.	36.
RT VERTICAL RESULTANT	127.80	332.73	102.92	87.	38.
SEAT LOADS (LB)					
LEFT LINK X AXIS	22.84	87.35	-139.03	158.	82.
RIGHT LINK X AXIS	7.59	11.94	-121.02	459.	92.
X AXIS SUM	30.23	84.47	-256.54	459.	82.
X AXIS MINUS TARE	30.84	70.53	-109.57	48.	88.
CENTER LINK Y AXIS	-35.78	-3.70	-165.68	201.	79.
LEFT Z AXIS	54.84	482.52	-2.70	81.	191.
RIGHT Z AXIS	43.39	388.19	43.83	81.	3.
CENTER Z AXIS	288.17	882.59	255.47	91.	201.
Z AXIS SUM	384.41	1747.01	311.89	82.	201.
Z AXIS MINUS TARE	384.24	1658.88	318.51	82.	214.
RESULTANT	387.41	1778.21	312.28	82.	201.
RESULTANT MINUS TARE	367.28	1670.28	318.70	82.	214.

CREST STUDY -GX TEST: 3079 SUBJ: A-8 WT: 169.0 NOM G: 10.0 CELL: D

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK				-89.	
2.5V EXT PMA		2.50	2.50	14.	1.
10V EXT PMA		10.01	9.99	368.	7.
SLED ACCELERATION (G)					
X AXIS	-0.09	0.52	-9.84	158.	55.
Y AXIS	0.00	0.25	-0.25	302.	123.
Z AXIS	1.00	2.54	-0.63	54.	50.
SEAT ACCELERATION (G)					
X AXIS	0.48	2.53	-10.05	160.	48.
Y AXIS	0.00	1.40	-1.31	180.	173.
Z AXIS	0.88	7.91	-0.58	54.	166.
SLED VELOCITY (FT/S)	0.00	90.95	0.00	154.	0.
CHEST ACCELERATION (G)					
X AXIS EXTERNAL	0.49	4.57	-12.74	148.	88.
Y AXIS EXTERNAL	-0.01	6.55	-8.91	155.	144.
Z AXIS EXTERNAL	0.87	14.46	-7.22	145.	156.
RESULTANT	1.00	17.80	-0.69	144.	316.
NORM RESULTANT	0.10	1.81	-0.07	144.	316.
HEAD ACCELERATION (G)					
X AXIS EXTERNAL	0.48	2.12	-8.65	273.	110.
Y AXIS EXTERNAL	0.02	0.49	-0.70	72.	166.
Z AXIS EXTERNAL	0.83	5.30	-17.09	185.	90.
RESULTANT	0.97	18.52	-0.75	90.	208.
NORM RESULTANT	0.10	1.88	-0.08	90.	208.
RT EXTERNAL	-2.13	881.80	-438.78	143.	87.
LUMBAR ACCELERATION (G)					
X AXIS EXTERNAL	0.47	2.94	-9.88	177.	85.
Y AXIS EXTERNAL	0.00	1.06	-3.83	57.	38.
Z AXIS EXTERNAL	0.88	22.62	-10.86	75.	38.
RESULTANT	1.00	24.10	-0.58	75.	239.
NORM RESULTANT	0.10	2.45	-0.06	75.	239.
SHOULDER LOADS (LB)					
TENSION	137.21	739.88	66.39	93.	210.
LEFT TENSION QAA	55.08	146.02	34.90	76.	183.
RIGHT TENSION QAA	45.09	141.02	36.79	77.	165.
LEG LOADS (LB)					
LEFT TENSION QAA	24.85	128.53	21.27	77.	169.
RIGHT TENSION QAA	40.04	116.16	36.81	77.	170.
ANCHOR LOADS (LB)					
LEFT HORIZ X AXIS	81.21	542.68	55.22	80.	505.
LEFT HORIZ Y AXIS	8.57	48.29	2.18	79.	208.
LEFT HORIZ Z AXIS	-17.94	-17.72	-74.02	0.	80.
LEFT HORIZ RESULTANT	84.13	548.84	58.52	80.	513.
RIGHT HORIZ X AXIS	59.08	509.03	46.17	81.	329.
RIGHT HORIZ Y AXIS	6.99	69.87	1.80	78.	319.
RIGHT HORIZ Z AXIS	2.63	17.55	-2.03	78.	30.
RIGHT HORIZ RESULTANT	59.58	514.06	48.40	81.	329.
RT VERTICAL X AXIS	-5.05	36.12	-5.98	91.	0.
RT VERTICAL Y AXIS	3.00	7.06	1.88	158.	25.
RT VERTICAL Z AXIS	80.01	327.90	78.06	88.	19.
RT VERTICAL RESULTANT	80.21	328.78	78.11	88.	19.
SEAT LOADS (LB)					
LEFT LINK X AXIS	34.25	87.10	-190.47	172.	82.
RIGHT LINK X AXIS	2.42	48.15	-120.13	305.	79.
X AXIS SUM	36.67	81.10	-249.40	514.	79.
X AXIS MINUS TARE	37.16	80.38	-91.63	48.	85.
CENTER LINK Y AXIS	-67.53	-18.80	-200.18	211.	75.
LEFT Z AXIS	35.73	822.80	28.28	83.	221.
RIGHT Z AXIS	42.24	467.43	13.78	85.	306.
CENTER Z AXIS	204.54	1005.10	207.18	111.	1.
Z AXIS SUM	282.51	1814.91	284.83	86.	1.
Z AXIS MINUS TARE	282.29	1821.87	282.89	86.	1.
RESULTANT	290.84	1938.80	293.01	86.	1.
RESULTANT MINUS TARE	290.48	1834.48	291.75	86.	1.

CREST STUDY -GX TEST: 3094 SUBJ: D-3 WT: 212.0 NOM G: 10.0 CELL: D

DATA ID	IMMEDIATE PREIMPACT	MAXIMUM VALUE	MINIMUM VALUE	TIME OF MAXIMUM	TIME OF MINIMUM
REFERENCE MARK				-118.	
2.5V EXT PWA		2.50	2.50	2.	137.
10V EXT PWA		10.01	9.99	22.	75.
SLED ACCELERATION (G)					
X AXIS	-0.02	0.48	-9.95	157.	55.
Y AXIS	0.00	0.25	-0.32	295.	121.
Z AXIS	1.00	2.60	-0.67	54.	50.
SEAT ACCELERATION (G)					
X AXIS	0.49	2.48	-10.12	158.	48.
Y AXIS	0.00	1.24	-1.27	178.	171.
Z AXIS	0.87	8.13	0.19	54.	163.
SLED VELOCITY (FT/S)	0.00	30.17	0.00	155.	0.
CHEST ACCELERATION (G)					
X AXIS EXTERNAL	0.50	3.01	-15.28	172.	86.
Y AXIS EXTERNAL	0.01	6.86	-2.84	93.	379.
Z AXIS EXTERNAL	0.87	13.70	-2.52	66.	225.
RESULTANT	1.01	16.58	0.15	87.	194.
NORM RESULTANT	0.10	1.67	0.02	87.	194.
HEAD ACCELERATION (G)					
X AXIS EXTERNAL	0.50	3.47	-10.91	266.	104.
Y AXIS EXTERNAL	-0.03	1.07	-1.03	201.	264.
Z AXIS EXTERNAL	0.79	3.24	-14.67	132.	96.
RESULTANT	0.94	17.70	0.36	99.	306.
NORM RESULTANT	0.09	1.78	0.04	99.	306.
RY EXTERNAL	-5.26	535.89	-334.26	128.	240.
LUMBAR ACCELERATION (G)					
X AXIS EXTERNAL	0.48	5.81	-12.52	168.	80.
Y AXIS EXTERNAL	0.01	8.28	-3.47	70.	163.
Z AXIS EXTERNAL	0.87	18.12	-4.88	72.	163.
RESULTANT	1.00	21.95	0.12	71.	256.
NORM RESULTANT	0.10	2.21	0.01	71.	256.
SHOULDER LOADS (LB)					
TENSION	81.11	886.26	18.60	88.	478.
LEFT TENSION QAA	56.35	168.38	33.62	81.	169.
RIGHT TENSION QAA	56.90	208.02	45.62	81.	169.
LEG LOADS (LB)					
LEFT TENSION QAA	22.89	192.07	20.68	77.	480.
RIGHT TENSION QAA	14.96	102.47	13.64	76.	8.
ANCHOR LOADS (LB)					
LEFT HORIZ X AXIS	51.45	587.78	7.58	81.	303.
LEFT HORIZ Y AXIS	2.88	10.83	1.28	84.	47.
LEFT HORIZ Z AXIS	-13.99	-8.64	-64.94	307.	76.
LEFT HORIZ RESULTANT	53.40	591.52	11.75	81.	307.
RIGHT HORIZ X AXIS	47.24	572.69	13.52	83.	489.
RIGHT HORIZ Y AXIS	2.33	43.87	-9.65	83.	194.
RIGHT HORIZ Z AXIS	0.63	11.55	-6.80	81.	38.
RIGHT HORIZ RESULTANT	47.30	574.48	13.53	83.	469.
AT VERTICAL X AXIS	0.93	53.52	0.33	91.	0.
AT VERTICAL Y AXIS	3.28	6.86	0.41	165.	54.
AT VERTICAL Z AXIS	105.24	387.46	68.77	88.	487.
AT VERTICAL RESULTANT	106.30	390.85	70.93	88.	489.
SEAT LOADS (LB)					
LEFT LINK X AXIS	8.08	88.07	-205.00	193.	81.
RIGHT LINK X AXIS	45.85	55.52	-76.28	176.	68.
X AXIS SUM	51.71	111.09	-278.84	193.	81.
X AXIS MINUS TARE	51.99	106.50	-120.18	178.	76.
CENTER LINK Y AXIS	25.53	43.48	-152.90	224.	77.
LEFT Z AXIS	73.50	785.53	24.37	82.	472.
RIGHT Z AXIS	45.26	552.87	3.22	79.	209.
CENTER Z AXIS	261.29	1034.73	261.53	78.	0.
Z AXIS SUM	380.05	2362.29	341.74	79.	223.
Z AXIS MINUS TARE	378.94	2273.29	344.59	80.	215.
RESULTANT	384.40	2383.21	352.56	79.	223.
RESULTANT MINUS TARE	384.33	2280.95	356.22	80.	225.

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